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RESEARCH AND THE PRODUCER.

THE last few years have witnessed the creation in Great Britain and other parts of the Empire of a large number of institutions and centres endowed or supported by Government grants, which devote much of their time to agricultural research.

Before answering the question as to the immediate value of such research to the primary producer, some attention must be paid to the senses in which both the terms "research" and "producer" are used. Sir Daniel Hall* defines "research proper as being concerned with the discovery of knowledge *per se*, knowledge which may have an economic bearing, as when it deals with a subject of immediate economic importance like the nutrition of a plant, but the pursuit of which has been prompted by the desire to extend man's understanding of a particular set of natural phenomena. In this type of research, the economic applications are a secondary consideration and often arise only indirectly . . . In agricultural research the discoverer has fulfilled his purpose if he has arrived at a principle and he is rarely interested in the details whereby it can be translated into practice." Again, research may be aimed at the solution of some practical problem such as the Froghopper pest in Trinidad and, as such, involves long and complicated work resulting in interesting investigations which can only be addressed to a very small section of cultivators. On the other hand, research is not involved in the placing of general information about improved farming which the ordinary cultivator or stock-keeper requires. Such information is already there for the asking and if producers fail, it is only because they have neglected to make use of it.

Several classes of producers have also to be considered. "In the first class may be placed the plantation industries growing a single crop on a large scale, often with a considerable backing of technical knowledge and capital. In this class may be included the growers of sugar, copra, rubber, tea, coffee, fruit, vines and various fibres. The second class embraces the great mass of primary producers who may cultivate more than one crop and keep stock, and whose operations may be large or small. Lastly, of increasing importance

* *E. M. B.* 33. The dissemination of Research results among agricultural producers. Answers to a questionnaire issued by the Empire Marketing Board with an introduction by Sir A. Daniel Hall, K.C.B., F.R.S.

in the Empire, come the non-European cultivators in tropical countries, dealing as a rule with very small areas of land by traditional methods."

It will be obvious from the above that each type of producer will require different information proceeding from research. The managers of plantation industries might, for instance, require highly specialised information proceeding from investigations. Generally speaking it may be assumed, however, that the results of research proper are no use to the planter or cultivator, as what he really needs is to be supplied with some of its deductions and consequences.

In the tropics, the results of research obtained at experiment stations mainly reach the producer through the medium of the Agricultural Department and its Staff of instructors or agricultural officers and in this connection it may be said that the Agricultural Department acts as the only link between the producer and the main research centres. The department should, therefore, be regarded as a very vital factor of any system of agricultural deveolopment in the tropics and provided it has proper staff, adequate facilities and the support of planters and business men, it should exercise a beneficial influence on the agriculture of the Colony in which it may be situated. Where there are large plantation industries, the maintenance and direction of a special station by those primarily concerned and devoted to each of these industries might be encouraged, however closely such a station might be associated with or administered by the Department of Agriculture. Where there are a large mass of primary producers, particular consideration should be paid to personal contacts through the agency of instructors and to the creation of demonstration and experimental farms or plots. The less intimate the personal contacts, the less effective the education will be although lectures, broadcasting, films, bulletins and journals are all suitable media through which results of agricultural research may be disseminated. "Where the primitive producers exist, the demonstration of the improved crop or variety, or practice of cultivation, or implement, alone is effective, but the instructor, whoever he may be, should make very sure that any change he proposes in the customary procedure will result in better crops." He should furthermore concentrate his efforts upon one prominent man in each village or family, trusting that the other members of the community will follow his example by degrees.

Next to the Agricultural Department, come research centres, such as the Imperial College of Tropical Agriculture, the Amani Institute, &c. Producers situated within the range of the activities of such centres will probably derive immediate benefits of some of their researches. The functions of these centres, however, were clearly defined at the 1927 Imperial Agricultural Conference when it was decided that they should "concentrate on problems requiring more prolonged research than could be normally expected from the technical Staff of any single administrative department, and on problems arising in more than one territory of the Empire". They are thus being mainly developed as reinforcements of the undertakings of the local Department and in no sense as substitutes for such activities. A similar type of research centre is also found in privately financed institutions such as the Trinidad Cotton Research Station and the Rubber Research Institute. The immediate connection between the producer and research therefore appears to end with these centres which are themselves, however, together with the Agricultural Departments, in direct touch with such institutions as the Imperial Institute, Kew, the Imperial Institutes of Entomology and Mycology, the Bureaux, the Imperial Economic Committee, the Empire Marketing Board and the great number of other bodies which exist in Great Britain to carrying out research proper in connection with tropical agriculture.

It will thus be seen that the sequence of educational and research centres, through which new knowledge will eventually percolate to the producer, is pretty well defined. It has been further consolidated recently by the formation of a unified agricultural service which is aiming at co-ordinating the work of Agricultural Departments throughout the British Tropics.

SUGAR RESTRICTION.

On 9th May the "Chadbourne export restriction scheme", providing for the regulation of sugar exports over a period of five years, was signed in Brussels. Final agreement on all outstanding points was reached between the various interests at a recent meeting in Paris. The main questions then settled related to the supervision of the working of the scheme, and to the conditions under which the allotted quotas may be exceeded. It has been agreed that exports may be increased by five per cent. if the average world price for sugar of a basis polarisation of 96 degrees has been established at the equivalent of 2.00 cents (U.S.A.) per lb. f.o.b. Cuba for prompt shipment, for a period of 30 consecutive working days. At a price of 2.25 cents a further increase of 2½ per cent. in exports may be permitted, and, should the quotation reach 2.50 cents for the prescribed period, the quota may again be increased by 2½ per cent., or by five per cent. if no increase has been granted at 2.25 cents. The scheme will be controlled by an international sugar council presided over by Mr. Francis E. Powell, Chairman of the Anglo-American Oil Company. The council possesses 90 votes, out of which 35 have been allotted to Cuba, 30 to Java, and 25 to Europe. The European votes have been distributed as follows: Czechoslovakia, 8 votes; Germany, 6; Poland, 6; Hungary, 3; and Belgium, 2. The three main producing countries which remain outside the convention are Russia, Peru and Santo Domingo. Negotiations with Russia had to be abandoned, but it is expected that the discussions with Peru and Santo Domingo will lead to a successful conclusion.—(*The Economist*, Vol. CXII, No. 4,577.)

FIJI SUGAR.

[*The following notes, describing in detail methods of cane cultivation in Fiji, were kindly contributed by Mr. F. C. T. Lord, Attorney of the Colonial Sugar Refining Company, Ltd., and should be read in conjunction with Professor C. Y. Shephard's article on 'Fiji Sugar' which appeared in Vol. VII No. 7. of "Tropical Agriculture." Our thanks are due to the Company for the photographs reproduced in this issue.*]

CANE FARMING has undergone further development since it reached the stage recorded in Professor Shephard's article. This year 87 per cent. of the total area supplying the mills is being cultivated by cane farmers, 48 per cent. being tenants of the Colonial Sugar Refining Company, Ltd., and 39 per cent. being native land owners. These farmers are nearly all Indians, though Fijians have also begun to enter the industry.

Preparation of the Land.

The method of cultivation followed by the Company on the land which it still retains, and by the tenant farmers, and which the Company endeavours to persuade the independent farmers to adopt, is, for the greater part of Fiji, as follows:

Each estate or farm is divided into four blocks on which a four years' cycle of operations is commenced in successive years. A typical cycle would proceed thus:—

November, 1930. Plough out ratoon stumps and bury trash.

December, 1930. Apply coral sand, 5 tons per acre. Apply Sulphate of Potash and Super-phosphate, 2 cwt. and 3 cwt. per acre respectively. On poor land: half these quantities, on good land: no application, on very good land: sow Mauritius Beans or Rice Bean.
Harrow.

May, 1931. Plough in green manure crop and harrow.

November, 1931. Plough.
Sow Mauritius Beans or Rice Bean on Company's estates.
Sow cowpea on farms.
Harrow.

February, 1932 Plough in cowpea on farms and harrow.

March, 1932. Drill through green manure on estates.
Drill through bare soil on farms.
Plant.

April - September, 1932. Weed and cultivate between rows as required, gradually working soil into drills and leaving ground level.

August, 1933. Harvest plant canes.
Place all trash between alternate pairs of rows. (Where insect damage is severe the saving of trash from plant crops is abandoned, the trash being burnt, all the land being thus left available for cultivation between the rows.)
Plough between rows where trash has been cleared.

September, 1933. Move trash on to ploughed strips and plough remaining land.
Apply nitrogenous manures, usually Sulphate of Ammonia at 2 cwt. per acre on second class land, and 3 cwt. per acre on first class land.

October - December, 1933. Weeding and cultivation as required.

October, 1934. Harvest ratoon canes.

Ploughing is performed on estates by tractors drawing—as a rule—double disc ploughs, and on farms by horse or bullock teams, drawing single disc implements. (Figs. 1 to 3.) It is unusual for farmers to own disc ploughs, which as a rule are hired from the Company as required; the charge being regulated to provide for maintenance of the implements.

Planting.

Planting is done in drills prepared by double mould-board ploughs, sets being distributed from planting carts on estates, and by hand on farms. It is usual to use sets about 12 inches long cut from plant canes 9 to 12 months of age. These are placed at intervals of about 20 inches between centres of plants, and covered by horse drawn tyne implements on estates, or hoed in on farms.

The standard variety is Badila, a New Guinea importation, which so far has given results superior to many others tried. On poor land a seedling variety named Pompey is used which was raised at the Company's Experiment Station at Rarawai in 1907. In one very wet district Malabar (Yellow Caledonia) is preferred to Badila, better ratooning qualities under the conditions being an important factor; and in another district about 50 per cent. of the crop is of the H109 variety which stands the extremes of wet and dry weather better than the standard variety.

Cultivating.

Cultivating between the cane rows is performed by animal traction, two methods being used (Figs. 4 and 5). On estates, however, nowadays tractor drought power is used for most inter-row work, disc or tyne cultivators being the usual implements.

Harvesting.

Gangs are arranged on a geographical basis, each cane farmer being required to take his place in a gang which reaps cane from all the farms in his neighbourhood. For instance, if a farmer has double the usual area he must supply an extra man.

At the beginning of each harvesting campaign, the farmers forming each gang, sign a mutual agreement, and authorise the Company to withhold from the first proceeds of each man's crop the sum of £5 as a guarantee of regular attendance. In the event of absence from the gang without reasonable excuse, it is agreed that the deposit may be paid towards an object, generally charitable, stated in the agreement. Amounts not appropriated are returned to depositors at the end of the campaign.

In order that the cultivation of farms may not suffer, the overseer in charge keeps a roster of the men employed, and arranges temporary leave

for each in rotation to absent himself from the harvesting gang. He records the attendance of each man and the number of cane trucks loaded by him. From weights supplied later by the mill weighbridge each man's earnings are calculated. Wages are advanced by the Company and recovered from the amounts due to the owners of the cane. It is usual for each man to cut and load one truck (about 2 tons) per day (Fig. 6).

Empty trucks are delivered daily by locomotives and taken into the field on portable tram lines to the point on the permanent way nearest to each gang's work. After the trucks have been filled and their loads secured by tightening the chains provided on them for this purpose, they are delivered to the locomotive at the same point, together with a waybill giving full particulars for the information of the weighbridge clerk. Each harvesting gang includes several horse or bullock drivers whose work it is to haul the trucks, empty and full, over the portable lines (Figs. 7 and 8). Locomotives haul loads up to 200 tons on the two feet gauge lines, and the longest haul is 83 miles.

INTISY RUBBER.

[*We reprint below a note extracted from the "Bulletin of the Imperial Institute"* (Vol. XXVIII, No. 3), *on "Intisy" a new rubber yielding plant, which it is proposed to introduce into cultivation in the United States.*]

INTISY is the native name of *Euphorbia intisy* Drake, an upright, woody, almost leafless shrub or tree, native to Southern Madagascar. It is reported to have attained a maximum height of 6 to 7 metres, with a stem diameter of 25 cm., but no trees of this size are known to exist at the present time, the largest apparently being in the neighbourhood of 4 metres. The shrub is found growing on dry rocky soil, in a region where a six months' dry period each year is the rule, and where droughts lasting as many years are not unknown. It is enabled to exist under these conditions by virtue of its very pronounced xerophytic structure, the roots possessing special swollen structures which serve as water-storage organs.

Euphorbia intisy was discovered in 1891 at Tsivory, Madagascar. Commercial exploitation followed at once, so that the annual exportation of rubber from Madagascar rose rapidly from less than 50,000 pounds to almost a million pounds. This ruthless exploitation, however, resulted in the plant being almost exterminated.

In 1928, a botanical-exploration expedition sent to Madagascar by the United States Department of Agriculture, in association with other bodies, succeeded in obtaining living specimens of the shrub. The desert-like regions of Southern and Western Texas are very similar in character to Southern Madagascar, and it is hoped that at some time *Euphorbia intisy* may be introduced into this area. It is understood that shrubs brought back by the expedition are now growing in Southern California and have withstood the climate during the past winter with no apparent damage. Living plants were also sent by the expedition to Marseilles and Algiers, whilst some were planted at Tananarive, the capital of Madagascar, but no information appears to have been published as to their subsequent growth.

The tree is readily raised from seed but there seems to be some doubt as to the age at which the tree can be economically tapped. Renault has stated that six-year old trees may be exploited but Prudhomme considers that it would be 30 to 40 years before the tree is in a suitable tapping state.

The rubber collected from *Euphorbia intisy*, known in commerce as "kilwa," "niggers," or "intisy," is said to have been of high quality. The native method of obtaining the latex from the tree appears to have been very simple and consisted of making cuts on any part of the trunk or large branches. The latex which exuded was allowed to coagulate on the tree without further treatment, although sea salt and lemon juice are said to be suitable coagulating agents. The rubber was then stripped from the cut and rolled into balls by hand. The yield of rubber from stems less than 3 cm. in diameter is said to be so slight that it does not pay to tap them.

Definite records of the yield of latex or the percentages of caoutchouc and resin in the latex do not appear to have been published. Bonnechaux has estimated that the yield of coagulated latex per tree per tapping made in such a manner as to have no injurious effect on the tree should be about 100 grams. It is reported that at the time when the trees were being ruthlessly exploited, spiral cuts were made all the way up the tree from the ground to the branches as small as two to three cm. in diameter, and as much as 15 lb. was yielded at one tapping. Such severe tapping, however, usually killed the tree outright and even less rigorous treatment, repeated several times, always brought about the death of the tree. Swingle, however, in a paper on the anatomy of the plant, published in the *Journal of Agricultural Research*, (Vol. XL, No. 7, April 1, 1930, pp. 615-625) states that "from what is known about tapping other rubber plants and about the stem anatomy of this plant, *intisy* would almost surely be able to live for many years if careful tapping methods were employed."

The rubber as collected by the natives contained up to 70 per cent. of foreign matter and impurity, but the washed material is said to have been of excellent quality, of a greyish-white colour, light brown in contact with the air, very pliable and elastic and with a high caoutchouc content. Prudhomme quotes a sample as containing 2.45 per cent. of moisture, 3.1 per cent. of resin and 1.5 per cent. of ash.

FIJI SUGAR.

(1) *Ploughing in cane trash with team of horses and a single disc-plough.*

(2) *Ploughing in Mauritius Beans with tractor and double disc-plough.*

FIJI SUGAR.

(3) *Ploughing in Mauritius Beans with tractor and four disc-plough.*

(4) *Cultivation between cane rows with single horse and board ploughs.*

THE CULTIVATION OF YAMS.

BY D. H. BROWN.

Botanical.

THE cultivated species of yam fall within two groups, viz.: *Dioscorea alata* and *D. esculenta*.

D. alata (The Greater Yam) is a strong-growing climber with quadrangular, winged stems which twine clockwise. The leaves are large, glabrous and sharply angled. The tubers are frequently large, variously shaped and usually dark brown in colour. The species is closely allied to some of the wild yams of Eastern Tropical Asia but shows signs of considerable selection under cultivation.

D. esculenta (The Lesser Yam) is described as a thorny climber with leaves kidney shaped at the base, pointed at the tip and somewhat hairy. The tubers are relatively small but are produced in quantity. Members of this species are easily distinguished from *D. alata* on account of their spiny, persistent roots.

Tubers of *D. esculenta* are produced less deeply in the soil than those of *D. alata* and they are therefore more easily lifted (11).

By some authorities the species *D. esculenta* is subdivided into numerous types according to the shape of the leaves and climbing habit of the plant. In the West Indies various local names are given to the different groups; the following is the classification of West Indian yams adopted by Sir David Prain at Kew in 1930 (12):

D. alata—Winged stem; climbs counter-clockwise; most varieties have aerial tubers.

D. trifida—(Cush-cush). Climbs clockwise.

D. esculenta—(Chinese). Climbs clockwise.

D. rotunda—(Guinea). Stems cylindrical; no wings; climbs counter-clockwise; short spines scattered unevenly along stem; flowers abundantly in the West Indies.

D. cayensis—(Yellow).

Distribution and History.

The Greater Yam (*D. alata*) is a native of the Eastern Tropics and has been known from the Indian Ocean to the Pacific for centuries. The distribution of the Lesser Yam (*D. esculenta*) is more confined and it is less widely known (10).

There is evidence of yam cultivation in India as long as three hundred and fifty years ago. Examples of *Dioscorea* are found wild over the whole of the peninsular of India; some are peculiar to the hot, damp tropical plains, others to dry tracts and a third set ascend to temperate regions and are met with throughout the Himalayas at altitudes up to 9,000 feet. The Elephant Yam which is frequently cultivated in the drier districts of the west coast is not a true yam, but is *Amorphophallus campanulatus* (26). There is a record of *Dioscorea* having been grown experimentally by one Gerarde in his garden in Holborn, London in 1597 (22).

The name "Yam" is said to be derived from an American or West Indian word passing through the Spanish and Portuguese "Inhame" and French "Igname" (22). In 1625 Purchas stated that there were "great stores of 'iniamas' growing in Guinea" (23) and twelve years earlier it had been reported that the same country produced "great abundance of 'inhames' . . . like the 'camottes' (sweet potatoes) of America and these 'inhames' boiled or roasted serve in place of bread." The 'inhames' referred to are reported to be the present day yams (24).

The date of the introduction of the crop into the West Indies was the early part of the seventeenth century—Verrill, in "The Bermuda Islands," suggests 1616 as being the probable date. It is at present grown extensively in these islands. In Trinidad insufficient is grown to supply local demand and considerable quantities are imported from Tobago, Grenada and elsewhere.

The yam provides a staple food for the natives of the wetter parts of West Africa. In Nigeria it is grown mainly between the latitudes 4° and 10° N. that is the whole of the southern and a considerable part of the northern provinces. There the crop is almost invariably grown in mixed cultivation with others such as maize, cotton, cowpea, plantains, &c.

In the Philippines yams are grown to some extent, but they are not of great importance as a food crop. This is probably due to the ease with which other root crops can be grown and the lack of a sufficiently dense population. *D. fasciculata* is indigenous there, and other species have been introduced (2).

Throughout the tropics the crop is grown, generally by the peasant cultivator for his own consumption.

In the southern states of the United States of America, the name "yam" is often applied erroneously to certain types of sweet potato.

Climate and Soil.

CLIMATE.

The yam is definitely a drought resister, but it must be remembered that although tolerant of dry conditions it nevertheless requires a heavy rainfall to reach maximum production. In Nigeria and the British Cameroons yams are cultivated in districts with an annual rainfall varying between 46 inches and 412 inches (although over the majority of this area the rainfall is below 100 inches per annum).

In Trinidad where the crop grows well the average annual rainfall is 64 inches.

The root system of the yam is not extensive but it appears to be capable of obtaining and holding sufficient moisture to carry it through comparatively long rainless periods; growth often continues when the weather is sufficiently dry to injure other vegetation.

SOIL.

A crop can be grown with the least amount of trouble in a sandy loam but on sandy land, unless there be a plentiful supply of vegetable

matter in the soil, the yield will not be great. The maximum returns are obtained from deep fertile clays, but unless these are properly managed the result will be a failure.

DRAINAGE.

Drainage is all-important. Compacted and wet soils hinder root development and too much water in a heavy soil may cause the sets to rot instead of growing.

It is suggested (7) that planting in the dry season may mean that the food supply becomes exhausted before the plant is large enough to manufacture food for itself, and that the best time for planting is therefore, with the early rains. This point will receive more attention later.

Primitive Methods of Cultivation.

The wide distribution of the yam crop has already been mentioned. It is grown on the one hand by the primitive native farmer in Africa, whose implements are confined to a couple of hand tools and at the other extreme by growers in a position to utilise modern machinery and labour and grow the crop on extensive lines. It is obvious therefore, that the two cases will have to be dealt with separately and as an example of the first, we may consider the method of cultivation adopted by the peasant proprietor in West Africa who relies on the yam crop to such an extent that a failure of the crop over a large area may easily mean famine.

SHIFTING CULTIVATION.

It is the custom there to practise the system of agriculture known as "shifting cultivation"; that is to say an area of bush is cleared, the land cultivated and cropped for a period of two to four years, the length of time depending on its fertility and the amount of additional land available in the vicinity; it is then allowed to revert to bush and to remain uncultivated for a number of years while recovering condition.

SEQUENCE OF CROPS.

Although the scheme of cropping during the few years when the land is under cultivation cannot be termed "rotation" in the true sense of the word, the crops are nevertheless arranged in reasonable sequence. There are two cropping seasons annually, and the late crop is usually interplanted among the early crop before the latter is harvested. Mixed crops are frequently grown and one crop of yams is taken during the period of cultivation. As often as not the yam crop is the first to be grown after the clearing of the bush.

CROP SEQUENCES INCLUDING YAMS.

The following are examples of typical cropping systems :—

1. TWO YEAR SCHEME.

	Early Crops.	Late Crops.
1st Year ..	Yams and Maize	Cotton and Maize.
2nd Year ..	Maize and Cassava	Cassava.

2. THREE YEAR SCHEME.

	Early Crops.	Late Crops.
1st Year ..	Maize	Sorghum and Cowpeas.
2nd Year ..	Yams	Cotton.
3rd Year ..	Maize and Cassava	Cassava, Maize, Cowpeas.

Cassava is generally the final crop of the sequence. This is harvested as required and the bush allowed to replace it.

YAMS AS FIRST CROP OF SERIES—PREPARATION OF LAND.

To return to the stage at which the land is being cleared, this is cutlassed, and burned in the dry season; trees are felled but their stumps are usually allowed to remain. Then, as soon as the early rains have rendered the land sufficiently soft, it is made up into "hills" arranged about four feet apart, by the use of a short-handled hoe. These hills are on an average about 12 inches high—lower in dry areas and on light soils, but up to 24 inches in districts of greater rainfall and on heavy land.

PLANTING.

The set or "seed yam" is then planted in the top of the hill. The actual operation of planting consists of digging the hoe at an angle well into the top of the hill, lifting it slightly and at the same time inserting a set underneath the blade of the tool. The hoe is then withdrawn and a little soil scraped up from the sides of the hill to the top in order to cover the sets to a depth of about three inches.

STAKING.

The set germinates rapidly and soon throws up one or more strongly growing shoots. When these shoots have reached a foot in height, stakes are provided upon which the yam vine may twine and climb; these stakes are cut from the neighbouring bush and should stand at least six feet out of the ground—if possible, one per hill.

MIXED CROPPING WITH YAMS.

In cases where mixed cropping is practised, maize is frequently planted alongside the yams. Three to five seeds are planted all in one hole in the side of each hill, a little nearer the top than the bottom. This is done immediately after planting the yam sets. All the seeds are allowed to grow—neither singling nor even thinning is practised and the maize stems provide support for the yam vines. This may be the only support which the yams receive, but better results are usually obtained where stakes are supplied in addition. It must be borne in mind, though, that in a great deal of the yam-growing districts, the wild vegetation is almost entirely grass and anything of a woody nature is rare and valued too highly to justify its use as a yam prop.

Another system, where a yam crop has been preceded by cotton, is partially to prune back some of the side branches of the cotton, leaving the plant standing to furnish a support for the yam vines. This is a most effective method of carrying on cotton pests from year to year, and in most circumstances the practice is to be condemned.

Yam as Sole Crop.

Again, in some areas it is customary to grow yams as a sole crop (as opposed to a mixture with maize, &c.) and on account of the scarcity of suitable supporting material the vines are left to trail over the ground. It has, however, been thoroughly established as a fact that where supports can be provided it is possible to increase the yield of tubers enormously.

Yams Grown During Latter Part of Sequence.

We have dealt so far with the case of yams grown as the first crop on a newly made farm and we now have to consider the alternative, viz.: where they are grown on land which has already been under cultivation for one season or longer. Under such circumstances there is a choice of planting dates, (*a*) the early part of the dry season or (*b*) the beginning of the following rains, and of these two seasons, other conditions being satisfactory, the former is considered to give better results. Planting with the rains can be carried out on exactly the same lines as those described for cropping a new farm, but with dry season planting an additional complication arises on account of damage by the heat of the sun which the set suffers if allowed to lie covered only by a shallow layer of soil during the hotter months of the year, when the shade temperature frequently rises above 100°F. For this method of planting, the old hills are moulded up as soon as possible after the late crop of the previous season has been harvested—before the soil becomes too dry and hard for cultivation. The yam set is then planted in the top of the hill, covered with a few inches of soil, and on this is placed a "mulch" or "cap" consisting of dry grass or similar material which is finally kept in place by a small quantity of soil or a large stone. This practice of "mulching" is absolutely essential where early planting is carried out in a hot climate, but under less severe conditions seed tubers will lie dormant in the soil during the dry season, without suffering any ill effects.

A trial carried out at the Imperial College of Tropical Agriculture in 1931 gave the following indications:

1. The provision of a mulch maintains an even and comparatively low soil temperature.

2. The natural soil temperature (*i.e.*, without mulch) in Trinidad is not sufficiently high to be injurious to yam sets planted in the dry season.

3. The presence of a mulch delays germination until such a time as the soil is thoroughly moist but the total final germination is not affected.

4. Mulching has no beneficial effect on yield as compared with an unmulched crop planted at the same time.

5. Yields from early planted rows (March), whether mulched or not were greater than rows planted later (June).

With the commencement of the rains the set begins to grow and from that time onwards its treatment is the same as for late sown crops. Stakes will be erected as required and weeding carried out as necessary through the growing season. The crop continues to grow well into the dry season before the leaves and vine commence to die off; the actual date at which leaf-shedding begins varies greatly with different varieties.

Harvesting.

Harvest may take place at any time during the dry season after the vines have died down. The whole crop may be lifted at once or on the other hand small quantities of tubers may be removed as required. Variations in harvesting practice will be discussed elsewhere.

Storage.

The storage of yams for food is usually a simple matter and compared with other root crops, they do not suffer so much from disease and rotting during storage. Care should nevertheless be observed when harvesting, for the greater the damage done in the way of cutting and bruising the greater will be the chances of decay. It has been mentioned that the crop may be left where it grew and tubers harvested from time to time, as necessary, so long as the weather remains dry. As an alternative all may be lifted and stored in a pit, being covered with a layer of not less than six inches of dry soil to afford protection from the sun; storage in buildings is also sometimes practised. A trial in 1922 (15) showed that where other conditions render the practice convenient the most efficient method of storage is to leave the crop in the ground until required. In the locality the dry season extended from October until March. Part of the yam crop was lifted as soon as it became mature and stored in buildings; the remainder was left in the field until January: the latter when harvested showed no signs of sprouting whereas the former commenced to send out shoots almost immediately upon being put into store. It must be borne in mind, however, that the labour expenses of lifting are greatly increased if harvesting is delayed until January, when the soil becomes baked hard by the sun. The preservation of tubers for seed is considered below.

Planting Material.

The type of set used varies greatly. In some districts it is considered that tubers weighing a pound or two each give the most generally satisfactory results; elsewhere only the smallest tubers weighing a few ounces are used or if these are not available, larger tubers are cut into sets about a quarter to half a pound each.

A practice which is adhered to in some districts consists of commencing to reap the main crop some time before the yams are mature, and while they are still growing strongly. The process consists of tunnelling into the side of the hill to expose the tubers, taking care to disturb the root as little as possible. The greater part of the tubers are cut away carefully leaving the "crowns" attached to the plant. The soil is then replaced and from the "crowns" somewhat irregularly shaped secondary growths are developed. These are harvested later and provide valuable material for seed. At Ilorin (14) where the common native custom is to harvest the main crop in September, experiments indicated that the farmer would be well advised to wait until rather later, except as regards those roots which he might require for his own immediate consumption. Similar trials at Ibadan (15) tended to show that in that district, harvesting in October was too late if a second crop was to be expected. These results are somewhat contradictory since the dry season at Ilorin is not only more intense than at Ibadan but, in addition, it usually begins a week or two earlier.

In a trial with various types of planting material at Ibadan in 1924 (17) the control plots were planted with "seed yams", *i.e.*, small tubers planted whole. The remaining sets consisted of (*a*) "tops" and (*b*) "bottoms" of larger tubers cut into halves (the "top" being the end nearer the point of attachment to the plant). The following figures refer to yields per acre:

Average yield of controls ("seed yams") 11,641 lb.
Average decrease in yield due to using
"tops".... 774 lb.
Do. do. "bottoms"....1,967 lb.

The conclusions which can be drawn from the above namely the superiority of tops over bottoms, and the still better results obtainable from seed yams, bear out the results of a similar experiment in Ilorin in 1922. The increased yield is bound up closely with the question of germination; seed yams frequently germinate a month earlier than cut sets planted at the same time.

Number of Seed Tubers per Hill.

On parts of the Gold Coast (8) it is the custom to plant about six inches from the top of the hill on the northern side so that the set may be on the shady side during the dry weather and to plant up three tubers to each hill. If good material is available it is doubtful if it is an economical practice to plant more than a single set. On the other hand a trial was undertaken in the Philippines (1) to ascertain the value of varying the number of sets per hill (the hills being one metre apart) with the following results for the twenty-three varieties under trial.

4	tubers per hill	gave the	heaviest	yield in	5	cases.
3	Do.	do.	do.	do.	6	do.
2	Do.	do.	do.	do.	12	do.
1	Do.	do.	do.	do.	0	do.
					23	

Inferior yields from the three and four tuber hills were probably due to (*a*) damage by cultivation (since the tubers were spread about the hill) and (*b*) vegetation became too crowded on the single pole provided for each hill. There were definite indications that certain varieties benefited from heavy planting and others from fewer sets. No allowance was made for the planting material used and this was not deducted in giving the returns.

Modern Methods of Cultivation.

We have dealt at some length with the general systems of yam cultivation by hand labour under primitive conditions and by way of contrast we will turn now to a few points connected with the growing of the crop where circumstances admit of the use of more up-to-date methods, including the employment of animal power, modern implements, manuring, &c.

Hills *versus* Ridges.

Many of the points connected with the growing of any crops are naturally common both to primitive and more elaborate systems of cultivation, but there are also essential differences. For instance, whereas in the case of primitive farming, yams are almost invariably grown in hills, under more advanced conditions it is general to plant them on long ridges. The explanation of this is bound up with the use of draught animals, implements and manures and the convenience of the "ridge" as opposed to the "hill" system under these conditions is obvious.

Green Manuring.

Among various improvements in cultural practice which have been studied (in Nigeria), green manuring in conjunction with the permanent cultivation of crops in rotation has received considerable attention. The native method of growing the crop on hills was found inconvenient when dealing with the green manure crops, the burying of which was greatly simplified when ridges were substituted. The standard practice adopted was to grow the green manure crop (usually *Mucuna utilis*) on the ridges, cutlass it when ready, spread it along the furrows, and split the old ridges over it, forming a new bank where the previous furrow had been and *vice versa*. Ridges of various sizes were tried with the ultimate result that six feet was selected as being a suitable width, the planting distance between yam sets along the top of the bank being 20 inches. There appear to be no disadvantages attached to this method, but on the other hand on sloping land soil erosion may, to a great extent, be controlled by making the ridges along the contours of the land. It is found that a heavy long-handled hoe is more convenient for building these ridges than the round-bladed, short-handled tool generally used in "hill" cultivation in the greater part of the yam growing area.

RIDGING AND OTHER METHODS OF PREPARATION.

It is well known that the yam grows to its best advantage in a soil that has been well and deeply cultivated, and for this reason big, well-formed ridges give best results. Ridges six feet in width have been suggested above; the whole of the soil between the centres of the banks should be tilled and the soil heaped up towards the ridge giving a section of the following appearance:—

It is not sufficient to make the ridges six feet *apart* for this might mean small ridges separated by a portion of untilled soil, thus:—

In connection with the depth to which the soil should be cultivated, experiments were carried out in 1923-24-25 (15, 16, 17). One treatment consisted of the method described above, *viz.*, building new ridges over the old furrows, while in another case the bottoms of the old furrows were thoroughly "trenched" before building the new ridges over them. These two methods of treatment were tested against intermediate plots under the native "hill" system.

There appeared to be little or no difference between the yields from hills and ridges, but there was an increased crop when the soil was trenched prior to ridging. This was particularly marked in two years when yields in general were low but in 1923, when the crop was twice as great, the increase on the trenched land was not enough to cover the extra labour expenses.

However, since the cause of the poor crops in 1924 and 1925 is not explained, the experiment loses a great deal of its value.

	1923.	1924.	1925.
	lb.	lb.	lb.
Average yield per acre on hills	14,407	7,014	6,745
Difference on ridged plots	+484±821	−1,053±791	−1,314±799
Difference on trenched and ridged plots ..	+1,461±821	+2,499±791	+3,562±799

In order to find a possible substitute for trenching which might be economical, further trials were carried out (18 and 19). In these, the bottoms of the old furrows were hoed to a depth of nine inches before making the new ridges over them. Results showed a slightly increased yield over ordinary ridging, but not sufficiently great to cover the cost of the additional labour requirements.

Green manuring in connection with yam cultivation has already been mentioned, and it should here be pointed out that although yams can benefit greatly from the turning in of a green crop, it is nevertheless of the utmost importance that the vegetable material shall be well buried and covered with sufficient soil to enable the set to be planted without coming into contact with the green manure. If the yam set be planted in actual contact with decomposing vegetable matter, there is every chance that decay will spread to the set which will then rot instead of germinating. Again, as the green material decomposes, the ridge will naturally subside to some extent; hence an additional need for building a large deep bank in the first place.

PERMANENT ROTATION AND MIXED CROPPING.

Mixed cropping on similar lines to local native practice was incorporated in the general scheme of crop rotation and green manuring, *e.g.*, cotton interplanted among yams. The following are instances of rotations, each including a yam crop, which are undergoing trial:—

	EARLY CROP.	LATE CROP.
1st Year ..	Yams ..	Cotton (inter-sown among yams).
2nd Year ..	Bengal Bean (for green manure)	
3rd Year ..	Maize ..	Bengal Bean (inter-sown among maize for green manure).

	EARLY CROP.	LATE CROP.
1st Year ..	Groundnuts ..	Cotton.
2nd Year ..	Maize ..	Maize.
3rd Year ..	Groundnuts ..	Bengal Bean (for green manure).
4th Year ..	Yams ..	Bengal Bean (inter-sown in yams for green manure).

Yam Cultivation in West Indies.

In the West Indies, with particular reference to Trinidad, it has been recommended (12) that the most suitable season for yam planting is shortly before the rainy season commences, the beginning of May for *D. alata* (Lisbon etc.) and rather earlier for Guinea, Yellow and Eboe. Quickly-growing catch-crops which will mature in six or eight weeks (such as cowpeas) are recommended for planting on the sides of the ridges. Maize may be grown but a good corn crop can only be produced to the detriment of the yams. In Trinidad and other countries enjoying similar climatic conditions, (typically insular) a yam crop harvested in January or February can be followed immediately by cabbages, cowpeas, beans or any of the usual dry season crops which will be off the land by the beginning of the rains.

Artificial Manuring, &c.

The great majority of yams are grown without manures. Experiments covering a period of four years in Porto Rico (7) indicated that where fertilisers are used, complete dressings should be applied. The standard manuring in these trials was 3,000 lb. per acre of a mixture giving five per cent. nitrogen, eight per cent. phosphorous and 12 per cent. potash. Plots treated with this gave an increased yield of 50 per cent. over unmanured plots whereas when either N, P or K was omitted from the mixture the dressing had no beneficial effect.

	Yields per hill.
No Manure	3.26 lb.
N+P+K	4.89 do.
N+K	3.14 do.
N+P	3.40 do.
K+P	3.18 do.

The crop was grown on six-foot ridges and planted at the beginning of the rains. P and K were thoroughly mixed with the soil in the upper part of the ridge and N applied in two top dressings after the plants had started growth.

Trials with stable manure showed that a dressing of ten tons per acre increased the yield by ten per cent., but a heavier dressing of 20 tons increased vine growth at the expense of the tubers. The plots in this experiment also received a complete dressing of artificials.

A common practice in the West Indies is to bury cane-trash or similar material in the lower part of the banks or hills. The efficacy of this practice was investigated at the Imperial College of Tropical Agriculture in 1931. The season was unusually dry with the result that a large amount of the cane-trash did not decompose. Consequently, the soil in the ridges was virtually insulated from the subsoil, the supply of soil-moisture was cut off and the resulting yield of tubers was lower than in control rows grown without trash.

To be continued.

WEST INDIAN HURRICANES.

Concluded.

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Section V.—Signs and Indications of an Approaching Hurricane.

In this section the position of an observer is assumed to be in the Eastern West Indies or Lesser Antilles.

There are many cloud formations and atmospheric conditions which serve as premonitory signs of an approaching storm, but the majority of these are apt to be unappreciated by persons who are not trained observers and are unfamiliar with every aspect of local weather. Every person who appreciates the potential danger of a hurricane and has the slightest knowledge of the nature of a hurricane is probably aware of the very common instrument known as the barometer and relies on the barometer to give definite warning of the approach of a storm. Unfortunately, however, in some circumstances the movement of the barometer cannot be regarded as a definite warning until the violent phase of the storm is only a few hours distant, but in such circumstances the type of clouds appearing from time to time, the direction of the wind, the weather in general and the condition of the sea will give more timely warning to the keen observer.

There are several distinct phenomena which indicate the existence of a hurricane, some of which are apparent when the centre of the hurricane is as much as one thousand miles distant. The different phenomena make their appearance in a definite order and, for convenience, they will be referred to in the following sections in the different phases of the approach and passage of a hurricane. It is not always that each phase in the approach of a hurricane is well defined. Local conditions may obscure from an inexperienced or untrained observer the more general influence on local weather phenomena of a distant passing or approaching hurricane. However it is likely that at least a few of the phenomena of the early phases will be apparent while the hurricane is yet several hundred miles distant. These signs and phenomena in the early stages cannot furnish a long-range forecast, but can only indicate the existence of an atmospheric disturbance.

The First Phase.—Some observers of many West Indian Hurricanes have concluded from their observations that surrounding the area of low pressure of the storm there is a ring or circular belt of high pressure ; that is, surrounding the cyclone there is an anticyclone (5). If this be the case, in its progressive movement towards a given point, the anticyclone of a hurricane must first be experienced. These observers record that in this phase the barometer rises

to unusual heights, the weather is exceptionally bright and fine, the sky is of a deep colour and free of clouds except where formed as the result of very local convectional currents over heated land, the wind is very light and variable in direction. This type of weather may last for one or two days and occurs when the violent portion of the hurricane is as yet three or four days distant. It is doubtful, however, whether these anticyclonic conditions are apparent in all cases, but note should be taken of the occurrence of such conditions as detailed above, if and when they occur.

The Second Phase.—After the very fine weather of the anticyclonic conditions there follows a spell of unsettled weather in which changes from very fine to overcast conditions take place rapidly. The barometer falls from the unusually high level to a more normal level: the winds continue light and variable: reddish or orange-red colourations may be apparent on the Eastern and Southeastern horizons at sunrise (because hurricanes approach from these points): and haloes are formed around the sun and moon.

Almost coinciding with this type of weather and appearing in advance of the more definite conditions to follow, very high clouds (Cirrus) appear in the sky. These cirrus clouds are of a very definite formation and are often commonly known as "Mare's tails." They somewhat resemble in form a feather or plume of very variable dimensions and are always snow white. In the majority of West Indian hurricanes of which careful records have been made, these cirrus clouds have travelled forward in advance of the hurricane in the same general direction of its movement. There is a tendency for these clouds to lie longitudinally in the same direction and point towards the centre of the storm.

Another distinctive feature in the sky is the appearance, soon after the characteristic cirrus clouds are observed, of a thin haze or veil of cloud gradually spreading from and thickening in the direction in which the cirrus clouds point or appear to converge. This thin veil of cloud causes haloes around the sun or moon, at first of a weak appearance and then later, as the cloud thickens, of unusual brilliance.

The position of an observer need not be considered dangerous unless the storm centre is in the Southeastern quadrant. In such circumstances the cirrus clouds would appear to converge towards a point within the Southeastern quadrant, and the veil of cloud would gradually thicken in the same quarter.

The Third Phase.—By the time the phenomena already described had made their appearance and the veil of cloud had begun to thicken noticeably, several other definite features would be making their appearance.

The barometer would now begin to fall slightly.

The wind would begin to blow from a definite quarter, very lightly at first and slowly increasing but maintaining a more or less constant direction.

An unusually long, but very definite swell would be observed in the sea causing a heavy surf on the coast in the direction from which the swell approached.

The first definite winds of a storm likely to pass over or dangerously near to an observer in the Lesser Antilles would blow from a point at or within East-northeast and North. These winds may be very light and unnoticeable at first except to careful and persistent observers. It is consequently always wise to be on the look out for other indications of a storm if at any time during the hurricane season the wind is observed to be blowing from a Northerly or Northeasterly direction. It does not follow, however, that whenever the wind blows from such a point that a hurricane or cyclonic disturbance is nearby. There are several other occasions on which the wind may blow over local areas from such a point.

The condition of the sea is a very definite indication of the existence of a hurricane. There are occasions when weather conditions suggest the existence of a hurricane but leave considerable doubt in the observer's mind. In such circumstances a calm sea or a disturbed sea with a well marked swell will enable an observer to form a definite conclusion.

It has been ascertained that the waves and swells of greatest size and length are developed in the right rear quadrant of the cyclonic area, move through the smaller waves in the front of the storm and are carried by inertia to the shore in the direction in which the cyclonic area is advancing at the time. A long swell from the Southeastern quarter with a rough sea on the Southeastern coasts of the island will indicate the position of a hurricane in a dangerous quarter. As the storm approaches, the sea becomes more disturbed and furious.

The conditions obtaining in the third phase may be observed while the centre of the storm and the area of violent winds is still 300 to 400 miles or more than 15 hours distant.

The Fourth Phase.—The indications of the approaching hurricane now become definite and it remains for the observer to predict whether or not the centre of the hurricane will pass over the position of the observer or to one or the other side. (*See* Fig. 3.) This prediction will be of considerable advantage in that it will be known in advance the manner in which the wind will shift.

The barometer continues to fall and soon falls rapidly.

The wind continues to blow from a definite point, but tends to become more gusty and irregular in force.

The sea becomes more and more furious quite independently of the strength or direction of the wind at the point of observation. At this stage the sea is roughest on the coast nearest to the centre of the storm and not on the coast facing the direction of wind which is as yet relatively gentle or moderate.

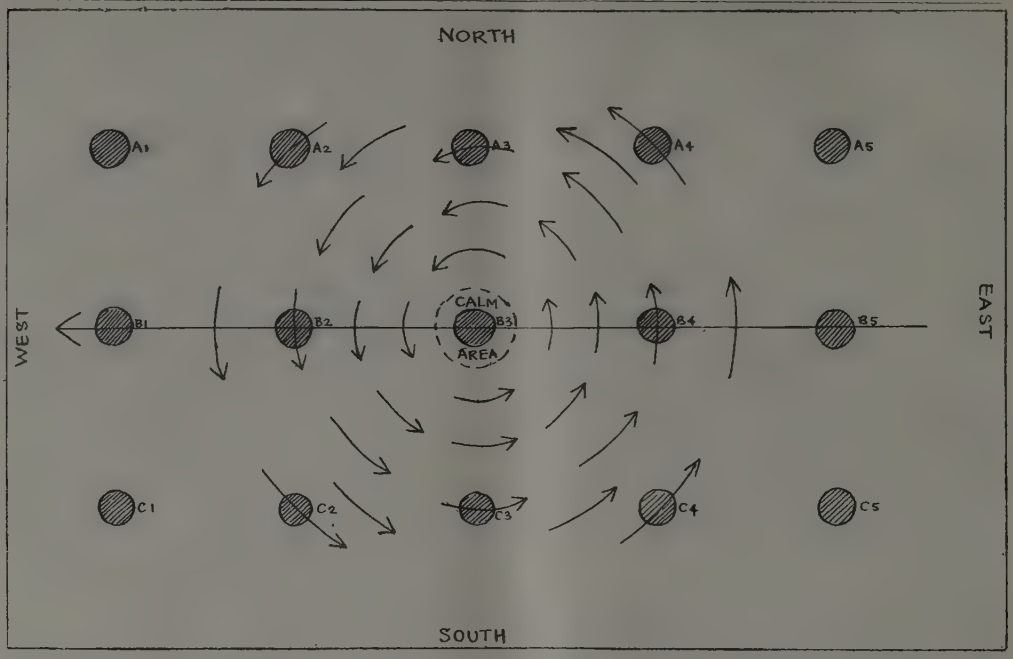

FIGURE 3. *In the figure the relative positions of a point of observation to the centre of a hurricane passing (a) to the south, (b) directly over and (c) to the north of the point of observation are demonstrated by the positions marked A1 to A5; B1 to B5 and C1 to C5 respectively. In the case of positions marked A1 to A5, the wind as indicated by the arrows changes from N.E. to E. to S. E.; in the case of positions marked B1 to B5 from N. to a calm and then S.; in the case of positions marked C1 to C5, from N.W. to W. to S.W.*

The thin veil of cloud, sometimes known as the cirrose veil, thickens rapidly: cloud formation begins to take place at lower levels, and detached clouds begin to pass over. The veil of higher cloud will thicken very appreciably in one quarter of the sky and the general appearance of the latter will become very threatening. If this stage should happen to coincide with sunrise or sunset there will be a most unusual colouration in the sky.

This latter phenomenon was very pronounced in Barbados at sunset on the 11th of September, 1928, when the great West Indian hurricane of September, 1928, was centred at about 150 miles to the North of that island. There was a very remarkable yellow-orange light lasting for a few minutes and then assuming a somewhat greenish tinge before dying away into reddish-grey and then darkness.

So long as the wind continues to blow from a point between Northeast and North, it is probable that the centre of the hurricane will pass over or near to the point of observation.

The thickest and darkest portion of the higher cloud masses indicates the position of the centre of the storm. If at this stage this portion of the higher cloud masses should happen to be in the Eastern or Southeastern quadrant from the observer it is probable that the centre of the hurricane will pass over or near to the point of observation; but if the centre of the storm should thus be indicated in the Northeastern, Southern or Southwestern quadrant, the position of the observer need not be considered dangerous.

It should be remembered that the further West a hurricane proceeds in the Caribbean area the more Northwesterly and Northerly will its course become. An observer in that section of the area should therefore regard as being more dangerous the approach of a hurricane from a Southeasterly or Southerly direction.

Section VI.—The Passage of a Hurricane: The Period of Violent Winds and Destructive Activity.

The phenomena connected with the passage of a hurricane will be dealt with very briefly in this article, a short account only of the natural course of events in a typical West Indian hurricane being given.

During the phases of approach of a hurricane as already described there has been little or no rain. The period of violent winds begins with a series of heavy rain showers and squalls with the wind velocity increasing suddenly to 40 or 50 miles an hour. Between the showers more or less continuous light rain and drizzles set in.

The barometer now begins to drop abruptly. As the centre of the hurricane approaches the point of observation, the rainfall becomes heavier and the wind more or less continuously blows

at hurricane force, but the most violent gusts occur with the frequent very heavy showers of rain. It is usual with these squalls for the wind to shift to the right temporarily for the duration of the squall, for example if the wind were blowing from the North, it would shift temporarily to the Northeast. Frequent lightning and thunder usually accompany the rain squalls in the violent portion of the hurricane.

Considering the case of a hurricane moving in a Westerly or Northwesterly direction, the direction of movement usual in the West Indies, if the centre is about to pass over the point of observation (*see* Fig. 3) the winds will continue to blow approximately from between North and Northeast until the centre of the storm, with its characteristic relatively calm area, arrives. There will then be a lull, with light variable winds. It is recorded that in certain hurricanes there has been a temporary break in the clouds during the calm spell. This calm or relatively quiet spell may last for about half an hour, but varies according to circumstances. The calm spell is abruptly terminated by violent gusts of wind and renewed rain from between South and Southwest exactly opposite to the direction from which it was blowing previous to the calm spell. In general, the second half of the hurricane is not so severe as the first half. The entire period of violence will usually cover a period of five to eight hours, with the short calm spell occurring midway between the opposite halves of the hurricane.

Now, if the centre of the hurricane passes to the North of the observer (*see* Fig. 3) the wind will gradually shift with continued violence from North, through Northwest and West, to Southwest and South, the most violent gusts being experienced between Northwest, West and Southwest.

Further, if the centre of the hurricane passes to the South of the observer (*see* Fig. 3) the wind will gradually shift with continued violence from North, through Northeast and East, to Southeast and South, the most violent gusts being experienced between Northeast, East and Southeast.

It has already been indicated in Section II that the velocity of the wind and the amount of rainfall are greater in the right half of the hurricane. The point of observation will therefore be within the more severe portion of a storm, the centre of which passes on its South side.

Hurricane Warnings and Precautionary Measures.

Hurricane Warnings.

Inasmuch as West Indian hurricanes usually move from East or Southeast to West or Northwest, the earliest reports of the existence of a hurricane must be made by observers in the Easternmost Islands or in ships passing East of the West Indian area.

The position of Barbados, the most Easterly of the Islands, is a most important one for receiving and issuing hurricane warnings. It usually happens that the most severe hurricanes of the West Indian area are those which have originated East of the longitude of Barbados. Further, no storm of destructive intensity or hurricane destined to pass over one or more Islands of the Lesser Antilles is likely to pass Barbados without influencing the local weather to a noticeable extent. It is therefore possible for an observer in Barbados to issue warnings to Islands West of Barbados at least 24 hours and often more in advance of the arrival of the hurricane at those Islands. Similarly, observers further West in the Lesser Antilles can issue warnings to Islands in the Greater Antilles.

A system for receiving and issuing hurricane warnings has been arranged among the British Islands in the Eastern West Indies, and the United States Weather Bureau at San Juan, Porto Rico, maintains an elaborate system whereby the weather conditions of the West Indian area during the hurricane season are daily communicated to it. In the event of stormy or other abnormal weather, the latter Bureau issues special messages of warnings for the benefit of the areas likely to be affected.

Several Islands maintain a system of warnings for the benefit of their inhabitants when the approach of a hurricane is indicated, but all Public Authorities should arrange for a system of cautionary and hurricane warnings to be brought into use for the benefit of the inhabitants when a hurricane is either suspected or definitely expected respectively.

General Precautionary Measures.

In all places where hurricanes are likely to occur, persons responsible for the care of all buildings, particularly dwelling-houses and hospitals, should take the following precautionary measures annually before the beginning of the hurricane season :—

(*a*) to ensure that all windows and doors of such buildings are fitted with adequate fastenings in proper working order, and to make provision where possible, for their extra support in the event of a hurricane ;

(*b*) to acquire and maintain in working order one or more storm lanterns or other suitable type of lamp, so that inhabited buildings may not be without light when electric current or gas supply for lighting is interrupted or purposely cut off, as will usually be the case during a hurricane ;

(*c*) to provide whenever possible shelter for animals normally exposed to weather conditions during the remainder of the year.

Immediate Precautionary Measures on Receipt of Warning.

On receipt of the storm warning, all windows and doors, particularly on the Northern, Eastern and Western sides (for places in the Eastern and central Caribbean area) should be immediately closed, tightly fastened and barricaded.

All domestic animals should be given such available shelter as may be regarded as reasonably secure, and wherever possible all persons should seek shelter as soon as the force of the wind becomes dangerous.

Wherever possible all fishing and other small boats should be immediately drawn up on shore well above the normal highwater mark and properly secured. It should be borne in mind that an abnormal rise in sea-level frequently accompanies a hurricane.

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(2) Isaac M. Cline—Tropical Cyclones.

(3) Dr. Harold Jeffreys—Theories on the Origin of Tropical Cyclones—*British Air Ministry Geophysical Memoirs, No.* 19.

(4) Mrs. E. V. Newnham—Hurricanes and Tropical Revolving Storms—*British Air Ministry Geophysical Memoirs*, No. 19.

(5) del Monte—West Indian Hurricanes, their Origin, Courses and Indications of their Approach (as quoted by E. B. Garriot in his *West Indian Hurricanes*).

Reference to Diagrams.

The captions of certain of the diagrams which appeared with the first part of this article, in the July issue of *Tropical Agriculture*, should read as follows:—

Fig. I. Showing the distribution of isobars and wind directions of a hurricane centred over the western end of Cuba. (Taken in part from *Supplement No. 24, Monthly Weather Review*, United States Department of Agriculture, Weather Bureau.)

Fig. IV. The broken arrows point to an area of low pressure to which the surrounding air moves with a deflection to the right (in the northern hemisphere) as shown by the curved arrows.

Fig. V. A stage further in the development of the more or less circular motion of the wind around a central area is shown.

SUPPLEMENTS.

The following Supplements to the Journal can be obtained on application to the Editor:

1927 Sugar Supplement ..		1*s.*
Sugar Cost Accounts	..G. C. Skinner	1*s.*
Wilt Diseases of Coconut Palms.—(Parts I and II)	H. R. Briton-Jones	6*d.* each.
Giant Moth Borer of Sugar-Cane.. ..	..H. Martyn Skinner	6*d.*

THE LIVERPOOL COTTON MARKET.

By R. G. Wood,
Liverpool.

In a previous article which appeared in this Journal (Vol. VII, No. 12) on "Cotton Prices," several technical terms such as "Spot" and "Middling" prices, "Hedge selling" "Longs and shorts," &c., were used that are every day expressions to those in the trade, but may not be intelligible to an outsider. In the following article on the working of the Liverpool Cotton Market an attempt will be made to explain these terms and phrases.

Liverpool is still the greatest cotton market in the world, attracting as it does every conceivable growth of cotton. Its warehouses seldom contain less than half a million bales and often as much as a million and a half.

Trading in the Liverpool Cotton Market is strictly confined to members of the Liverpool Cotton Association, the Market having two distinct sides; one dealing in "Futures" and the other in "Spots." Each is entirely independent of the other, yet, paradoxical though it may seem, they are completely dependent upon each other. The Futures market deals only in contracts. All business must be transacted during the official opening hours, which are normally 10 a.m. to 4 p.m., a bell being rung to denote both the opening and the closing of the markets. All business must take place on the floor of the Exchange. This is a very spacious room, containing three distinct Rings; the largest in the centre of the floor, is the American Ring, while in the north-east corner is the Egyptian Ring and in the south-east corner the Empire and Miscellaneous Ring.* Each Ring has its own particular set of traders, business going on simultaneously in all three Rings. Generally speaking, these markets move in sympathy with each other, following the lead of the American Ring. There are exceptions, of course, particularly in the relative movements of American and Egyptian prices. For example, at the moment of writing, owing no doubt to the abnormally large visible supply of Upper Egyptian cotton (Uppers) and the poor demand for fine counts (the quality of yarn spun from Uppers) the difference between the two markets is much narrower than in normal times. The quotation for Fully Good Fair Uppers (about the middle Egyptian grade) is 6.22 per lb. while that for middling American (about the American middle grade) is 5.37 per lb., a difference of 85 pts. (85/100ths. of a penny) against a normal difference of at least 200 pts. (twopence) per lb. But there will come a day when a big demand for Egyptian cotton will cause the differences to widen, and then it is possible the American market will close lower and the Egyptian higher. As a rule the Empire market keeps in line with the American market.

* Since this was written a new contract for East Indian Cotton has been introduced which has practically taken the place of the Empire contract.

Still dealing only with the Futures market, there is an unwritten law that no sample of actual cotton is ever seen on the floor of the Exchange. The Futures trader is quite distinct from the Spot salesman. The trader's commodity is a contract, the salesman's contract is a commodity. The floor of the Exchange may be visualized as follows: attached to each of the three above mentioned Rings is a large board divided into thirteen columns, each column representing a particular month, the current month always coming first. Should it be the month of March, the first column will be for March, the others going right through the year until the following March. Incidentally trading can take place for two years ahead, any such business being recorded in a different coloured chalk. Alongside the American and Egyptian boards are two smaller ones, showing the movements of the New York and Alexandria markets, their official prices being cabled through every three minutes; Liverpool also sending her prices to them at the same time. At the beginning of each day all the boards are in readiness, containing the previous day's close of all the markets. When the bell is rung at 10 o'clock trading commences, and the price of every transaction must be quoted. In American the minimum contract is for 100 bales (480 lb. per bale), Egyptian 33 bales (720 lb. per bale), Empire 50 bales (480 lb. per bale.). If the contract is only for the minimum number a star is placed alongside the quotations on the board. At noon each day, a committee from each Ring fixes the official mid-day prices and also the closing prices. Trading is not valid either before the opening or after the close.

It may be interesting to show how prices move. Most markets try to keep in line with each other. Some days it will be New York that sets the pace, then Liverpool may take up the running. Alexandria often does the unexpected and occasionally New Orleans comes from out of the "also rans." Keeping to Liverpool as the example, the process may be explained as follows: At the beginning of each day the official board is posted with the previous day's closing prices of Liverpool, New York and New Orleans. Our time, of course, is about five hours ahead of New York. Liverpool deals in pence, New York in cents. When we close at 4 o'clock it is about 11 a.m. in New York and as already explained, we have received by cable their 11 o'clock prices. The chief object is to keep the parity right between the two markets; this will be explained later. If, after Liverpool closes, New York shows any movement either up or down, the difference between the 11 a.m. prices and their close is our guide. For example, taking a single month, at 11 a.m. yesterday, May delivery was 10.10 cents, but during the later session the market advanced to 10.40 cents, *i.e.*, 30 pts. better, then Liverpool is due to open 15 pts. up next morning (the American cent being only half the value of the English penny) and the chances are that it will do so unless some important factor has arisen after the close in New York, *e.g.*, if there is a crop scare, a large fire, a vessel sunk, or anything that is likely to enhance prices, Liverpool will open relatively higher. Factors that have a bearish trend will cause the market to open lower than we should have done on parity.

Parity is really the cost of shipment from one country to another. The actual cost at present of bringing cotton from New York to Liverpool (freight, insurance, landing charges, &c.) is about 110 Liverpool points or $1\frac{1}{16}$ penny per lb. At the time of writing the quoted differences are only about 60 Liverpool points. Thus when it is said that the "straddle" is narrow or wide, it means in this case the differences ruling between the New York and the Liverpool markets. A straddle may also mean the operation of buying one month and selling another month in a particular market, *e.g.*, buying May and selling October at a given difference, in the hope that at any time before the end of May the differences may widen, when the operation is reversed. Say 100 bales of May are bought at 5.60*d.* and 100 bales of October are sold at 5.40*d.*, *i.e.*, 20 points difference. Later on, if the straddle has gone the way it was expected, May delivery has stretched to 40 pts. over October. If the straddle is then reversed it would show a gross profit of 20 pts. equal to £40 on 100 bales of American cotton. It makes no difference to the ultimate result of the straddle if the trend of the market as a whole has been up or down, so long as the May position has appreciated the 20 pts. extra over October.

To show in figures the complete operation:

1st March, 1931.

Bales.	Bales.
Buy 100 May at 5.60.	Sell 100 Oct. 5.40

7th May, 1931.

Sell 100 May at 5.00.	Buy 100 Oct. 4.60
60 pts. loss.	80 pts. profit.

80 pts. profit on October.
60 pts. loss on May.

20 pts. nett profit = £40 in cash.

Straddles also take place between different markets. A large volume of business is done between Liverpool and New York, also between American Futures in Liverpool and Egyptian Futures in Liverpool, and also between the Liverpool Egyptian Market and the Alexandria market.

The term "hedge selling" is probably the commonest of all in use, and it is also the most important. All cotton in these days, with perhaps the exception of a few bales from China, Java, Australia, and other lesser growers is hedged. This means that, in order to guard against the fluctuations of the market from the time of shipment until arrival at destination, the equivalent weight of the actual cotton being shipped is covered by a collateral contract in the Futures market. All American cotton

imported is bought on c.i.f.* terms at "seller's call." It is seldom the actual price is fixed at the time of sale, "seller's call" meaning that the seller of the cotton has the option of fixing the price at any time before the arrival of the cotton at its destination. All cotton is sold on "basis," that is, so many "points on" or "off" the Futures price of the month on which the contract is based. A fuller explanation of this will be given when we deal with the spot market; suffice it to say that when a shipper wishes to "fix" his cotton; that is, the price at which he wants to invoice it, he instructs the buyer to sell an equivalent weight of Futures, *i.e.*, if 100 bales of actual cotton is being shipped, 100 bales of Futures will be sold against the cotton. This is one form of hedge selling. The terms "near" and "distant" months, mean that the first three or four months following the current month are called the "nears," and those following the "distants".

A term frequently used in the Ring is an Only. This applies to dealings with the current month. If the time of the year be January, a trader wishing either to buy or sell 100 bales for January delivery, will not ask for, nor offer, 100 bales of January, but will either bid for or offer "An Only." This really means 100 bales of the current month. "Swops" is another name for Straddles.

"Longs" and "Shorts" are the terms used to denote the position or interest dealers have in the market. If they have bought cotton, they are "long," if they have sold cotton, they are "short". "Bulls" and "Bears" are somewhat similar terms, excepting that they only denote a man's opinions as to the course the market is likely to take. A Bull is one who looks for higher prices, a Bear for lower prices.

When the closing prices are struck they invariably carry a word with them to indicate the closing tone, such as, strong, weak, easy, idle, irregular, firm, &c.

"Jobbers" are certain men who trade in the various rings, and make their living by buying and selling the market for a quick return. They might justly be called universal providers, for without them, the free flow of trading could hardly go on. They like to buy at the buyer's price and sell at the seller's price, while the ordinary trader with legitimate orders to execute without delay, invariably has to buy at the seller's price and sell at the buyer's price. Between the buyer's and the seller's price there is roughly one point difference. Until quite recently a fixed charge of one-half per cent. commission for non-members and one-quarter per cent. for Associate members of the Liverpool Cotton Association was the schedule charge, but now the commission is governed by the actual value of the market; the lower the market the higher the rate, the higher the market the lower the rate of the commission. In New York there has always been a definite fixed rate, irrespective of the price of cotton.

* Cost, Insurance and Freight.

The foregoing is a fair description of the Futures market and its relative terms and phrases, and it will be followed by a similar description of the methods of the Spot Market which deals with actual cotton.

REVIEW.

HINTS ON EQUIPMENT AND HEALTH FOR INTENDING RESIDENTS IN THE TROPICS.

By J. Balfour Kirk, M.B., D.Ph. Second Edition, 1931. 128 pages with Index. *Baillière Tindall & Cox.* Price 3*s.* 6*d.*

A little book, full of sound and useful information that will abundantly repay the pleasant task of reading, both by hardened sojourners and those contemplating residence in the tropics.

The practice of the advice given in the chapters on matters of personal hygiene, clothing, food, drink, exercise and rest, if followed, would certainly enable individuals to avoid much of the debility and invaliding associated with life in the tropics. The information on insect carriers of disease and the methods of preventing infection is well expressed and full of valuable practical hints. There are a number of chapters on miscellaneous subjects, including medicines, which will also be found exceedingly useful.

E. A. S.

NEW USE FOR RUBBER.

Paragutta, a new compound of purified gutta-percha or balata and rubber, has recently been introduced by an American Company as an insulating material for submarine telephone and telegraph cables. The new product, from the ingredients of which nitrogenous bodies have been almost wholly eliminated, brings rubber into use for submarine cable insulation, a field from which it has hitherto been excluded. The low price of rubber and the plentiful supply, as compared with the more expensive guttapercha or balata and their limited supply, make its use as an insulator very advantageous.

In order to free the rubber from its nitrogenous constituents it is heated in an autoclave at a temperature of 150°C. for about ten hours in the presence of water alone. The best results are obtained by the treatment of latex. After cooling it is coagulated with acetic and thoroughly washed. The other steps in the processing of paragutta are very similar to those used for guttapercha, and involve blending and washing the deproteinised rubber and deresinated balata or guttapercha together, masticating to remove excessive water and at the same time incorporating such waxes as are necessary. The material is then strained through fine sieves and kneaded to remove air and finally placed on the covering machine rolls to be forced around the conductor. No vulcanisation process is involved in producing paragutta. — (*Manchester Guardian Commercial*, 28th May, 1931.)

SOUTH AFRICA'S CITRUS INDUSTRY.

By J. C. Eyre, B.Sc., Agric. (Stell).

The Problems and Organisation of the South African Citrus Industry.

Two great industries have grown up in South Africa during the last thirty years, the Deciduous Fruit Industry, largely confined to the winter rainfall area of the Western Province, and the Citrus Industry which is distributed throughout every Province.

The orange was first imported into South Africa in 1654, the original trees being brought from the Island of St. Helena by the early Dutch settlers. After the Great War there was an extremely rapid expansion of the citrus industry which may be ascribed to the following causes :—

(1) Good climatic and soil conditions for the cultivation of citrus.

(2) An expanding market in England, and the fact that citrus imports from other countries are lowest when South Africa markets its fruit.

(3) The experimental and organisation work of the Agricultural Department.

(4) The example of established and successful industries in California and Florida.

(5) The financing and development of vast estates as speculative enterprises. The subsequent division of these estates into farms suitable to the needs of :

(6) The large numbers of post-war settlers interested in fruit growing.

(7) The post-war boom.

The following figures from a census taken in 1927 of the citrus trees grown for commercial purposes give an idea of the size and recent development of the industry :—

Under 3 Years.		3-4 *Years.*		5-7 *Years.*		8 *Years or more.*		
Oranges.	*Grape-fruit.*	*Oranges.*	*Grape-fruit.*	*Oranges.*	*Grape-fruit.*	*Oranges.*	*Grape-fruit.*	Total.
948,909	71,804	761,915	10,027	661,669	5,958	678,035	9,801	3,132,118

Of the total number of trees, 2,069,739 are in the Transvaal.

The size of the export trade in citrus may be gauged from the export figures for the last three years.

1928	49,108 tons *
1929	67,083 tons
1930	112,908 tons

As a large proportion of trees have not yet reached maximum bearing capacity there will be still greater increases in exports in the next few years.

Citrus growers have been confronted with many problems, some of which have been solved, while others are yielding to research and efficient organisation. Many of these problems are general throughout the world, others are peculiar to South Africa, and thus can best be discussed under different heads.

Climate—Cultural.

Citrus in South Africa is grown in widely different climates ; in the Western Province the rains fall during the winter months—May, June, July and August ; in the Transvaal and Natal the rains fall during the summer months, while in the citrus areas inland, from Port Elizabeth and, approximately, 150 miles on either side, the climate may be said to be all-the-year-round as far as rainfall is concerned. The nearest approach to West Indian climatic conditions is found in Natal which is, however, only sub-tropical.

It has been found that apart from other conditions these different climates will not grow the same varieties equally well. For instance, most of the Transvaal is quite unsuitable for the growing of Navels for which parts of the Eastern Province are ideal. Good quality grapefruit require an elevation of not more than 2,000 ft. and an equable climate, conditions which are found in the areas round Port Elizabeth. The Washington Navel is unsatisfactory in the Transvaal, and because of its inferior quality, " drop ", and its consequent large size and somewhat coarse character, a large proportion of the one million Navels planted in this Province will have to be top-worked, replaced by other varieties or abandoned. The areas where irrigation is unnecessary are extremely limited. The rainfall is normally sufficient in the areas growing citrus provided adequate provision is made for obtaining sufficient water by conservation.

Understocks.

The majority of trees are budded on to the Rough Lemon (*Citrus limonia*) understock, the type in most general use being the Mazoe Rough Lemon which is feral along the banks of the Mazoe River in Rhodesia. This stock is practically identical to the type of Rough Lemon stock used in Florida. The rough lemon cannot be considered ideal because it has not the same degree of resistance to Collar Rot as the Sour or Seville Orange (*Citrus aurantium*).

The Sour Orange, largely on account of its high resistance to Collar Rot, has proved to be the almost universal stock, although it has been a

* One ton is approximately 17 standard cases.

complete failure in South Africa. Some thirty-five years ago this stock was recommended for trial and many groves were planted with varieties budded on it. The trees have, however, practically without exception, all died: they will grow well for a few years after which they become dwarfed or die. The Sour Orange itself, or when it is budded on to Rough Lemon will develop normally, although oranges, tangerines, or grapefruit budded on it always fail. The lemon budded on to Sour Orange will develop into a normal tree. The most obvious reason for the failure of Sour Orange is that unsuitable strains of this somewhat variable species were used, in spite of the fact that introductions of this stock at different times and from different countries in every case proved to be quite unsatisfactory. It is possible that a suitable strain may be found but before conclusive results can be obtained much experimental evidence will have to be collected.

The Trifoliate Orange (*Poncirus trifoliata*) is rarely used as an understock on account of its dwarf character. Collar Rot precludes the use of the Sweet Orange in any but very dry areas and even then its use is inadvisable.

Research on understocks is urgently required and a beginning has been made at the recently opened experiment station at Nelspruit. Many years must elapse, however, before definite and reliable results are available. The failure of the Sour Orange has vividly shown that South Africa will have to solve the majority of her citrus problems by experimental work carried out in the country as experiences and results of experiments carried out in other countries cannot always be regarded as applicable to any country, not even when conditions are very similar.

Varieties.

Seedlings are grown to a very large extent; there being numerous different types all exhibiting different characters. Some types are good while others are quite unfit for export either because they are inherently bad "carriers" or because they are inherently sour and research directed to sorting out the best types is needed. Many South African seedlings are of exceptional flavour. The Valencia Late is of most importance to the country and future plantings in the Transvaal will probably consist of this variety which yields good crops of reliable quality. The Washington Navel answers well in some areas but not in others. Other varieties are grown but are of very negligible importance at present. The grapefruit varieties most in favour are Marsh Seedless and Triumph, the former being by far the most important. Other varieties are being tested but will have to show considerable advantages to displace Marsh Seedless. It is unlikely that there will be any further extensive plantings of grapefruit as the market for this is so largely controlled by Florida. The average quality of the South African grapefruit is not up to the Florida standard, although South Africa is in the fortunate position of being able to market its grapefruit when supplies in England are very low. Tangerines are exported but only to a comparatively small extent.

Nurseries.

In an average grove considerable variation in the size of individual trees is found which is caused by planting variably sized nursery trees. On the whole the very best trees have not been planted, as owing to the rapid growth of the industry, nurseries have "sprung up" all over the country, which have, in many cases, been managed by persons with little or no experience of this somewhat exacting work. Thus, the nurseries which supply very good trees have had to compete with small businesses which are prepared to sell inferior trees. The average price of three shillings for trees is too low. It has not been sufficiently realised that trees which are backward and off-type in the nursery will remain so, and that if they are planted it will perhaps mean the lapse of five years before the farmer notices that some of his trees are smaller in size and unthrifty.

The seed used is often from unselected trees when it should come from as few trees as possible and only from those which have been known to give uniformly good stocks. Seedling plants are not sufficiently selected and 50 per cent. at least should be discarded. Before budding, the trees should also be carefully examined and all small or off-type trees (about 25 per cent.) discarded. Finally, before the trees are sold there should again be rigorous selection and particular attention should be given to the root system.

The question of bud selection cannot be fully discussed here but it may be mentioned that it is being practised more and more every year in South Africa. In any case it always entails very little extra expenditure and on the evidence available it would appear to be justified. The propagation of nursery trees from known high yielders must reduce the risk of reproducing inherently poor bearers. Nurseries are periodically inspected by Government Officers to avoid the spread of disease and it is not an uncommon occurrence for a nursery to be quarantined. It would be a big step forward if trees could be sold under a Government or Citrus Exchange certificate which would show that they were up to a definite standard and the fact that nurserymen sell different grades of trees is a reflection on the South African grower.

The use of vegetatively propagated stocks in preference to seedlings needs investigation as such stocks will give a very much more uniform grove. It is probable that the method that will eventually be used will be layering.

Irrigation.

The bulk of South African citrus is grown in areas which are comparatively dry and which have a very irregular and unreliable rainfall. In any one area the rainfall may vary from 20 to 50 inches from year to year and at the same time the rains cannot be relied upon to fall during exactly the same months every year. In one season the rains may commence in September and in the next there may be no good rains until December or January. The citrus tree not being

deciduous, requires a certain quantity of water throughout the year and the farmer must therefore make provision for supplying it to his trees during the dry periods and seasons.

The great majority of farmers obtain their irrigation water from permanent streams and rivers and as this in many cases entails expense far beyond their means, the water required is obtained on a co-operative basis, or the Government or large syndicates owning the land in the first instance constructing the necessary engineering works. The most notable scheme is that constructed by the Zebedelia estates where water sufficient to irrigate 2,800 acres is obtainable. The average citrus farmer in South Africa has had no experience of irrigation farming and for this reason many irrigation practices are unsound. It is thus found that soil erosion, alkali, black alkali, Collar Rot, &c., are more prevalent than they should be although experience is slowly teaching the grower how to make the best and most economical use of his water supply. In some instances groves have been planted without any provision at all being made to supply irrigation water, while in others no thought has been given to the lay out of the grove in relation to supplying water to the trees.

Capital outlay well spent would be a competent engineer's fees for surveying the farm and planting the lay out of the groves in relation to making the best use of the water available. To take an extreme case, there are too many farmers who plant groves and then find that the land cannot be properly irrigated without the installation of expensive pumps and pipes because water will not flow up hill. There are others who lose very large quantities of their top soil because furrows are at too much of an incline. It cannot be over-emphasised that one of the most important considerations in planting new groves is the question of water in regard to supply, cost, availability and quality.

Fertilising.

Soils from light sandy loams to heavy clays are found in South African groves. The best soils are the deep rich alluvial ones along the banks of some of the rivers, notably the Kat River, Sundays River and Fish River. The correct use of fertilisers is little understood by numerous growers, some of whom will say that their groves do not pay and that therefore money spent on fertilisers would be wasted. In many of these cases the judicious use of fertilisers would probably make all the difference between a profit and a loss. It is in the application of nitrogen that mistakes are made. The kind of nitrogen manure, whether organic or inorganic, and the time at which it is applied, are both very important questions. Faulty nitrogen applications will, in many cases, mean poor quality fruit and largely for this reason some growers have been averse to applying Kraal Manure (Pen Manure). There is little doubt, however, that for a grove to continue to produce maximum crops both organic and inorganic manuring are essential. Cover cropping will increase the fertility of the soil but must be considered as of secondary importance when compared with Kraal Manure.

Citrus Tree Records.

Each district, each farm, and each tree, has its own particular problems and it is only recently that growers have been forced to regard the individual tree as their unit of production and not the grove or acre. To enable a grower to find out which trees are not paying their way it is essential that tree records be kept which entail the systematic and periodic examination of every tree in the grove. By this means the grower is able to weed out, or specially treat, his unthrifty or diseased trees while at the same time he will learn much of value concerning the physiological activities of his trees.

Pests and Diseases.

South African citrus growers have had to contend with most of the pests and diseases which are found on citrus in the world. The outstanding disease has been the Citrus Canker, which was introduced into the country on some Trifoliate stocks. Forced eradication by burning (with compensation) and continuous inspection of the infested areas has resulted in the almost complete disappearance of this disease. Scale is very prevalent in some areas but is satisfactorily controlled by fumigation and spraying. False Codling Moth (*Argyroploce leucotreta*) and the Mediterranean Fruit Fly (*Ceratitis capitata*) give trouble in some areas.

Picking and Packing.

Every care that is taken in picking and packing amply repays the grower. In the past all packing was done on individual farms and methods were haphazard and crude. The marketing advantages of selling a few standard brands, the extra time which the farmer is able to give to his farm, and the expense of packing machinery, have led to co-operative packing where distances between farms are not too great. Co-operative packing has every advantage. Co-operative picking by trained men has started in South Africa but to only a very limited extent and as labour difficulties become more acute it will increase.

South African citrus has had the reputation of arriving wasty. Waste is characterised in the majority of cases by the presence of the common Green Mould (*Penicillium digitatum*) and the Blue-Contact Mould (*Penicillium italicum*) both of which gain an entrance through mechanical injuries. However slight the injuries may be, they will invariably lead to waste and for this reason the utmost care in packing and handling should be exercised. Dipping the fruit in bi-carbonate of soda is practised to a limited extent but cannot be regarded as more than supplementary to careful picking and packing.

The Export Regulations.

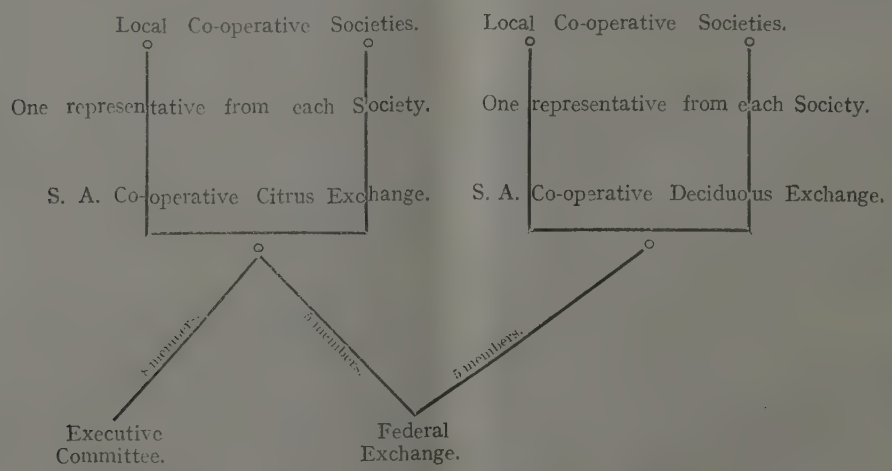
Up to 1914 the export of fruit was uncontrolled and as there were no standards, speculators took advantage of the prevailing conditions. The Government realising that an export industry could not be established under these conditions, passed the "Fruit Export Act" of 1914, by which all fruit exported, both deciduous and citrus, had to bear the Government stamp which guaranteed that it was of the standard required by the regulations. To enforce these regulations a fruit inspection service was inaugurated, the cost of which is borne by the growers in proportion to the amount of fruit they ship. At first all citrus fruit was inspected on arrival at the port of export, but with the development of the industry it has been found practicable and advantageous to the farmer to inspect a large proportion of the fruit before it is railed. As waste occurs in transit to the coast a second inspection is made in these cases, but the percentage examined is smaller. Each year additions and alterations are made to the regulations by a committee representing both the Agricultural Department and the growers. The tendency is to make the regulations more severe as production increases and this is likely to continue as a certain proportion of fruit that is exported should be excluded from overseas markets.

A very large step forward was made in 1928, when all oranges were required to show a certain ratio of total soluble solids to anhydrous citric acid. A certain percentage of the South African crop must be definitely called Sour and some standard other than the individual taste of the inspector was required to prevent this fruit from reaching the market. The ratio varies for the different varieties of orange. When it was realised that the ratio was too narrow, it was widened and in the future the standard will become still higher. Sour oranges are allowed to be exported, provided they are labelled "Sour" or "Tart" according to their degree of acidity. In an average season rejections have amounted from seven to ten per cent. of the fruit submitted. The principal causes for rejection are unsound condition (mould, wastage, mechanical injuries, insect pests causing waste, &c.), underweight, and poor quality (badly blemished, scale, and inferior quality, though possibly up to weight, &c.). The weight of a box of fruit gives a very good idea of quality. Other reasons for rejection are faulty packing, uneven sizing, excessive bulge, incorrect marking, broken and dirty boxes, and immature fruit. The amount of colour shown by the fruit must reach a definite standard.

It is by making the export regulations more severe that the quality of South African fruit can be improved.

The Organisation of the South African Citrus Exchange.

The outcome of a representative meeting of fruit-growers held in 1921 was the formation of the "Fruit-Growers' Co-operative Exchange of South Africa" which represented the interests of both the citrus and the deciduous industries. Large citrus interests were opposed to the exchange and at the formation of the "Perishable Products Export Control Board" one of the main functions of the exchange fell away, *i.e.*, the obtaining of and regulation of shipping space. In 1925 it was decided that there should be two central exchanges and the "South African Citrus Exchange" was registered in 1926. The following scheme gives an idea of the composition of the exchanges :—



The functions of the Federal Exchange are confined to overseas problems of a very general nature affecting the whole fruit industry.

The Citrus Exchange consists of thirty-six directors, each representing a local co-operative society and when it was found that this committee

was far too large most of the work was delegated to an Executive committee of eight members. The Central Exchanges are financed from the Government levy on exported fruit (five shillings per ton). The Citrus Exchange represents 70 per cent. of the industry. The functions of the Citrus Exchange are as follows:—

(1) To dispose of citrus fruits of its members in the most profitable manner.

(2) To manufacture or treat the citrus fruits of its members and to dispose of the fruit so manufactured, or partly manufactured, in the most profitable manner.

(3) To purchase or otherwise acquire on behalf of, and to apply to, its members agricultural implements and machinery, fruit boxes, seeds, fruit trees, manure, and other articles necessary for the production and sale of fruit.

(4) To provide by purchase, hire, construction or otherwise, cold storage for the fruit of its members.

(5) To commence and carry on crop insurance, orchard spraying or cleansing, fruit packing and other fruit farming operations for its members under a co-operative system.

(6) To engage competent persons to carry out any of its objects and to give instruction and advice to its members on fruit farming operations.

(7) To acquire and distribute information as to the best manner of carrying on fruit farming operations profitably.

(8) To acquire and distribute information on the markets of the world and on co-operation in general.

There are various other miscellaneous objects.

In practice the majority of these functions are exercised through the local co-operative societies. The most important work of the Exchange is connected with the marketing of the fruit. In the past all growers consigned their produce to private salesmen, the majority of whom were at Covent Garden. It was realised that this state of affairs was most unsatisfactory, the chief reason being that no attention was given to efficient distribution or to the opening up of new and undeveloped markets. The grower shipping his fruit through the Exchange may nominate his own salesman or market, in other cases the Exchange uses its own discretion. At first the quantity of fruit marketed by the Exchange was small but in 1929 it handled 55 per cent. of the crop and in the future it is likely to handle a still higher percentage. The "Overseas Farmers' Co-operative Federations" were appointed distributors, but in 1930 the Citrus Exchange opened its own distributing office in London. The Citrus Exchange has always had before it the example of the extraordinarily efficient distribution and marketing of "Sunkist" oranges by the Californian Citrus Exchange.

To market all South African Citrus under one co-operative brand is an ideal that is never likely to be attained. There are enormous distances separating areas producing different grades and types of fruit. Some local co-operative societies market fruit very much superior to the general average. The good reputation of some marks has been obtained either through a particular area being exceptionally favourably placed or through the particular society demanding a very high standard. Some fruit is marketed under the individual grower's name or brand and some under a co-operative society's brand. There are, however, far too many different marks on the market, and unless the number is very considerably reduced, advertising and efficient distribution will lose much of its force.

The Perishable Products Export Control Board.

Up to 1925 shipping space was inadequate, with the result that in some seasons there was considerable banking up and thus serious losses to the farmer were entailed. The Government took matters into their own hands by creating the "Fruit Export Control Board" the main duty of which was to make provision for and allot shipping space. In 1926 the Board was replaced by the "Perishable Products Export Control Board" which consisted of three members nominated by the Government—one was to be the Chairman, one a representative from each of the Citrus and Deciduous Exchanges, and one member to represent the interests of the export egg industry.

The functions of this Board are:

(1) To obtain adequate shipping space for present and future needs.

(2) To see that ships selected have refrigerated space suitable for the special exports.

(3) To make recommendations to the South African Railways concerning the welfare of the export fruit industry.

(4) To equalise freight rates.

At first there was fairly considerable opposition to this Board but today there are very few farmers who would not say that the Board had rendered very valuable services to the industry. To enable the Board to carry on its work no person is allowed to export fruit without its consent and intending exporters are required to furnish estimates of the size of their crop. A contract was made with the Union Castle Steamship Company and under it the Company are required to provide suitable cold storage space for 6,500 tons of citrus per week rising to 7,000 tons per week. At the same time the freight rate was fixed at £2 12s. 6d. per ton.

Transport.

Transport expenses bulk large in the fruit growers' budget. In the past large quantities of fruit arrived in England in a wasty condition which was in many cases due to unsuitable transport conditions. As much of the fruit has to stand 1,000 miles on the railways followed by 17 days on the ship, it must be in very sound condition and all cold storage and transport arrangements must be absolutely sound.

The railways form a very important link in the transport of the fruit. The type of truck that is used is being steadily improved and the cattle truck which was at one time employed for the transport of some of the fruit has by now completely disappeared. The railways are responsible

for the handling of the fruit from the time it arrives at the up country station to the time when it is stowed in the ships' cold chambers; the boxes being usually only handled three times.

All fruit must, under normal circumstances, be pre-cooled to 40° F. within 36 hours of its receipt in the store. The pre-cooling and storage chambers at Cape Town have a capacity of 60,480 cases with loading facilities for 2,600 cases an hour. Some fruit growers have erected their own cold storage plants and to carry this fruit a truck has been designed which will maintain a temperature of 33°F. for 60 hours without re-icing. Cold storage chambers have been erected at Durban and at Port Elizabeth refrigerated lighters are used which, however, have been worked at a loss. As fluctuations in temperature lead to waste, the Agricultural Department has started an experimental cold storage laboratory at Cape Town, which has carried out work of great benefit to the industry. Most of the value of this work, however, lies in designing and superintending the construction of trucks and of the cold chambers, both at the ports and on the ships. The question of storing fruit in England to await a more favourable market needs investigation.

It has been estimated that a loss of £60,000 is incurred through the arrival of fruit in a wasty condition. In the past much of the waste was without doubt due to faulty transport activities but today the percentage of waste from this cause is probably very small.

Markets and Competition.

South Africa has a white population of just over a million and a half, and her needs for citrus are thus very soon satisfied. A large proportion of the population is also rural and cannot be considered as part of the citrus consuming public. The local markets are dominated by the large quantities of ungraded fruit supplied by non-exporting growers. Attempts are being made to improve the packing and grading of this fruit for internal sale but it is unlikely that there will be any results of value. The South African growers are more or less entirely dependent on overseas markets and more especially on Great Britain. They are in the fortunate position of being able to market their citrus during the months of June, July, August, September and October, when the only serious competition comes from California, Brazil and the Argentine. It is, however, during these months that owing to home grown fruit the consumption of oranges in the United Kingdom is not as great as during the winter. In 1929 South Africa's share of the total citrus imports into England was approximately one-fourteenth.

Competition with California is severe but it is restricted very largely to the north. Brazil and the Argentine have commenced to export citrus to England and competition from these sources will continue to become more acute every year. Australia is too far distant ever to become a serious competitor. A large percentage of trees have not yet reached maximum bearing capacity and with the increased competition from other countries it will be necessary for South African growers to expand their markets, although the market in England has by no means been exploited to its limit. The first direct shipment was made to Canada during the last season and results were very promising. France is a potential market. The prospects of exporting fruit to Italy depends very largely on shipping facilities. The Scandinavian countries and Germany have taken a certain percentage of the crop in the past and are likely to take more in the future. In many continental countries there are difficulties with import duties to be overcome.

One of the chief handicaps of the industry has been its lack of advertisement as it is extremely difficult to advertise a large number of different brands of variable quality. The fewer brands, therefore, that are marketed the more effective and simple will advertising and distribution become. The flavour of the South African orange is second to none and an excellent reputation for quality is being steadily enhanced. The Californian growers owe much of their success to the fact that they market fruit of a standard and reliable quality under the very attractive name of "Sunkist".

By-Products and the Problem of the Sour Orange.

The total percentage of culls from South African groves is high and should and will be higher in the future. A fairly high proportion of the crop cannot be exported because the fruit is too sour. In the past, South African fruit has had the justified reputation of being sour and apart from its flavour much of this fruit is of excellent quality. It is now passed for export providing the boxes are labelled "Sour" or "Tart" according to the degree of acidity and whether this is a wise step is a debatable point but something had to be done to save the growers concerned.

Experiments are being carried out to investigate the possibilities of manufacturing citrus by-products. There are flourishing squash factories but because units are small and supplies irregular there has been little or no export. To establish a market for a product of this type much advertising is necessary and to derive any benefit from advertising supplies must be regular and large. The export trade in orange and lemon squashes depends very largely on whether the manufacture and marketing are undertaken on a co-operative basis by the Citrus Exchange.

Conclusion.

The citrus industry in South Africa is now firmly established and providing attention is given to the problems raised, there is no reason why citrus farming should not give an adequate return to the grower. Special consideration will have to be given to establishing new markets, advertising, reducing the number of brands, improving quality, and increasing co-operative picking and packing, marketing and distribution. The quality and size of the crop can only be increased by regarding the individual tree as the unit of production.

TROPICAL WORLD NOTES.

Bahamas.

The Report of the Bahama Agricultural and Marine Board for 1930 mentions that the year was generally favourable to agriculture. Active steps were taken to organise the marketing of tomatoes in Canada and a Central Packing House was installed in Nassau. Shipments commenced early in November, increasing rapidly in volume to the end of the year. The New York market proving unprofitable, the services of the Board were increasingly in demand for shipments to Canada, which at the close of the year amounted to over 10,000 crates per week. The resulting heavy demand for crating presented some difficulty the more so as the Board had no funds from which to pay the cost until the proceeds of sales in Canada were received. While at the beginning of the season two-thirds of the crop went to New York and one-third to Canada, at the close of December the position was reversed, two-thirds going to Canada, and most of the New York Commission Agents cancelled importation.

The fruit found a wide distribution in Canada, being carried by rail as far as 2,600 miles from Halifax and Montreal. Intensive advertisement of Bahamas fruit was undertaken by the Fruit Importers, Ltd. Prices, though not ranging as high as obtained in the past in the New York market, were profitable up to the end of the year. Advances between fifty and seventy cents per crate were made by the Board on behalf of the Fruit Importers, Ltd., as soon as shipments were despatched, and on receipt of the final sales accounts it was found that the better qualities generally gave another dollar per crate, or slightly more. Co-incident with the collapse of the New York market there was a decline of prices in Canada, but excepting for some small lots of very inferior pack, no shipments showed any loss, and it seemed probable that the fall in price would to some extent be equalized by the reduction of freight rate to Canada, and between Eleuthera and Nassau, as also by a reduction on the cost of crate material.

The output of sisal fibre dwindled to the lowest on record, the value of exports being only £4,600 as compared with £12,000, the lowest previous record. Although this decline of prices and exportation must be attributed to general depression in overseas markets, there can be little doubt that the Bahamas Sisal Industry is about to be extinguished, unless the quality of the fibre and the methods of marketing improve.

The principal defect has always been the method of salt water retting practised in the Bahamas. This can only be overcome by resort to machine decortication. The Board has given attention to a contrivance designed by a local resident, which seemed to meet local requirements, and in order to test it had a model manufactured, which, however, required some alteration to make it entirely suitable, so that it had not been fully tried out before the close of the year. The contrivance was pronounced by experts in England to be unsatisfactory, but in the absence of reasons for this verdict, and in face of the fact that it does apparently give satisfactory results, the Board is not convinced that it should forthwith be abandoned, and it is understood that the makers are so persuaded that it can be a success that they propose to persevere with the project on their own account.

* * *

Bermuda.

According to *Agricultural Bulletin* (Vol. X, No. 1) issued monthly by the Bermuda Department of Agriculture, an agreement has been reached between the Board and Department and the licensed shippers of Bermuda vegetables, by which one broker will in future be selected in the "key" markets of Canada (*i.e.*, Halifax, Saint John, Montreal and Toronto) to represent the Colony's farmers and shippers. By effecting this change in the method of marketing Bermuda vegetables (which in the past were consigned to jobbers and wholesalers), it is hoped to secure wider distribution of produce and better prices. The new scheme will also prevent competition which was brought about by the consignment of vegetables to a number of jobbers in the same area. Shipments in future will be allocated according to the needs of the markets. The broker's duties in Canada will be to ascertain his customers' requirements of Bermuda vegetables and to cable this information to Bermuda where a committee of the Board and shippers will decide on the distribution of any surplus which may be delivered for shipment. Brokerage rates are not to exceed five per cent., prices of vegetables will have to cabled within three days and account sales forwarded within fourteen days of the receipt of the vegetables. The scheme is at present in the experimental stage.

* * *

Siam.

According to the Department of Overseas Trade Report (*Economic conditions in Siam*), the value of rice exported up to the first quarter of 1930 showed a considerable decrease. Export of this commodity has been handicapped in several ways. Siam's largest customers are in normal times British Malaya, Hong Kong and China. The first of these is at the present time suffering from slumps in her two principal industries, tin and rubber, and is inclined to turn to cheaper sources of supply such as Cochin-China and Burma, whilst since April the considerable fall in the price of silver has made difficult the export to Hong Kong and China. Further, it would appear that holders of padi in Siam have not yet realised the world-wide drop in prices, and have been keeping back large quantities in the hope of obtaining better prices later on. Thus, while the amounts exported in January and February, 1930, were about normal, after that they fell consistently, with the result that many of the large rice mills, both in Bangkok and in the provinces, have been compelled to close down.

STUDENT INVESTIGATIONS.

THE following is a list of some of the papers prepared by students while in residence at the College. These are available in the College Library for reference.

1929-1930.

E. G. A. BENSON, B.SC., Agric. (Lond). ..	Part 1. Some indications regarding the behaviour of the Uba and B. 156 cane stool upon defoliation.
	Part 2. Observations upon the final growth of plant canes under different environmental conditions.
N. R. FUGGLES, B.SC., Agric. (Lond). .. Dip. Agric. (Cantab.) Dip. Agric. (Wye)	1. Soy bean selection in Trinidad together with investigations of nodule formation in College soil.
	2. Quantitative leaf characters of citrus varieties with reference to their diagnostic value for indicating stock behaviour together with an investigation of the causes of bench root in citrus seedlings.
G. GRIFFITH, B.SC., PH.D.(Wales) ..	The organic matter of cacao soils.
H. L. GROGAN.	Investigations on begasse.
S. T. Hoyle, B.A. (Cantab.)	Some observations on cotton with a note on the working of the pumping plant.
R. JOHNS, N.D.A., C.D.A., C.D.D. (Aberystwyth). ..	Notes on some of the insect pests of the maize plant.
A. J. KERR, B.A. (Cantab.) ..	Tobacco growing in Trinidad.
R. J. A. W. LEVER, B.SC. (DURHAM) ..	Trinidad chrysomelid beetles on leguminous plants.
G. W. LOCK, N.D.A., N.D.D., C.D.A. (Midland Agric. College), and J. L. SCOTT, B.SC. (Edinburgh). ..	An economic survey of the cacao industry in the Sangre Grande District.
B. A. LOWE, B.A. (Cantab.), Dip. (Agric.) (Cantab.).	The desirability and possibility of improvement in the cacao producing industry.
C. W. LYNN, Dip. Agric. (Wye) (1928-1929). ..	A developmental study of two procumbent varieties of groundnuts (*arachis hypogea*) with special reference to factors responsible for and affecting yield.
J. P. MAULE, B.A. (Cantab.), Dip. Agric. (Cantab.) ..	The digestibility and nutritive value of certain fodders in Trinidad.
J. E. MILL	A dissertation upon coffee in Trinidad accompanied by a description of the coffee on the College Farm.
F. B. NOTLEY, B.SC. (Birmingham) ..	Some insects connected with the maize plant.
F. B. NOTLEY, B.SC. (Birmingham), and R. JOHNS, N.D.A., C.D.A., C.D.D. (Aberystwyth) ..	Stored maize pests on the College Farm, and some experiments on fumigation with carbon bisulphide.
G. M. RODDAN, B.SC. Agric. (Glasgow), N.D.A. ..	1. The valuation of cacao estates with special reference to Trinidad, B.W.I.
	2. Cacao survey 1929-30. Yields in Trinidad, B.W.I.
J. B. G. SAVORY, Dip. Agric. (Wye.) ..	An investigation on the soya bean in Trinidad.
J. L. SCOTT, B.SC. (Edinburgh). ..	1. Mortgages and their effect on the Trinidad cacao industry.
	2. Rainfall as a factor in the Trinidad cacao industry.
J. STEELE, N.D.A., N.D.D., and G. M. RODDAN, B.SC., Agric. (Glasgow), N.D.A. ..	Cacao survey 1929-1930. "The Northern Range," Trinidad, B.W.I.

FIJI SUGAR.

(5) *Cultivation between cane rows with disc Cultivators.*

(6) *Loading cane on trucks.*

FIJI SUGAR.

(7) *Transporting cane to the factory.*

(8) *Loaded trucks of cane awaiting crushing.*

COLONIAL AGRICULTURAL DEPARTMENTS.

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CHEMICAL NOTES.

Compiled by the College Department of Chemistry and Soil Science.

Some Developments in the Oil Palm Industry.

The following note is abstracted from an article by M. M. Langton, M.A., B.Sc., F.I.C., published in *The Industrial Chemist*, Vol. VII, p. 71, which gives an account of modern development in the production of palm oil. The writer traces, in particular, the change from the old native handling methods to the modern mechanical operations, and discusses the factory system established in Sumatra. It is calculated that by using native labour and native methods 50 per cent. of the available pericarp oil is lost. Moreover, the oil so produced tends to be of lower grade than that obtained by the mechanical methods employed in modern factories producing palm oil.

Many operations have to be considered in the efficient equipment of factories, and amongst some of the operations which have occasioned controversy may be cited the following :—

1. The relative merits of sterilising whole bunches before stripping off the fruit and of sterilising the fruits alone.

2. The necessity or otherwise of "depericarping," *i.e.*, removing the oil bearing pericarp or pulp of the fruit before extracting the oil. Today in no case in Malaya or Sumatra is depericarping of the fruits practised, and probably this operation is for the time discarded.

3. The relative merits of hydraulic pressing, as opposed to centrifugal extraction, for removal of the oil from the palm fruit.

In regard to sterilisation, the present practice both in Malaya and in the Krupp factories in Sumatra is to collect the bunches of palm fruits just when ripe, convey these immediately whilst whole to the factory in steel basket trucks by rail, the trucks being hauled up by cranes and packed into large steel sterilisation chambers. The bunches are there subjected to steam at 40 lb. per square inch pressure for 30 to 40 minutes. This practice is preferable to stripping the bunches in the field and conveying the fruit only to the factory. Labour is saved in the field and, as the fruits are afterwards stripped in a mechanical stripper under expert European supervision, greater efficiency results. In this manner oil containing only 2.5 per cent. of free fatty acid is regularly obtained. Prepared by the older methods the oil may contain from 10 to 40 per cent. of free fatty acid.

In the centrifugal system of palm oil extraction the fruit bunches are first sterilised and are then delivered to stripping machines for separating or threshing the fruit. The loose fruits are then agitated under steam pressure to remove the pericarp from the nuts. The nuts and the separated pericarp are then placed in a high speed centrifuge where, with the aid of steam, the oil is separated. The extracted fibre and nuts are then delivered to a rotary separator. The nuts are then dried over a kiln or by means of a special machine though sun drying is the usual native method. The kernels are thus shrunk from the shell.

The difficult problem of cracking nuts mechanically has been overcome. A machine giving an efficiency of 95 per cent. of clean, cracked nuts, few of the kernels being damaged, has been devised. For the efficient working of the machine it is advisable in a preliminary operation to size the nuts with a mechanical sorter and to introduce only one size of nut at a time into the cracking machine.

The problem of separating the palm kernels and palm nut shells has presented considerable difficulty. There are substantial objections to the use of both brine and clay baths which separate the shells by flotation. A separator has been evolved, however, which by utilising the principle that the kernels have a greater tendency to roll than the nuts, can work with a 91 per cent. efficiency. The capacity of the machine is approximately 10 cwts. per hour, while the initial cost is less than that of a brine or clay bath installation of equivalent capacity.

Improvement in methods of shipping palm oil have closely followed the mechanisation of the extraction process. The soft wood casks and more recent iron drums which have in the past been employed for the transport of palm oil are being superceded by ships fitted with large oil tanks for transport in bulk. The oil is loaded into railway tank waggons at the factory and is transported to the coast where it is transferred to large storage tanks capable of holding from 200 to 250 tons and being heated by steam or electricity to 150° F. The oil can be transferred from the storage tanks to oil tankers at the rate of 125 tons per hour. Chemical control can be maintained throughout the shipment. It has been shown that the increase in acidity of a pure oil during storage is negligible, that there is no increase in iron content after three months storage in clean iron tanks, and that the oil obtained after bulk transport is more uniform and of higher quality than that obtained after cask or drum transport.

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Insecticidal Plant Industry in the Virgin Islands.

The possibility of establishing an insecticidal plant industry in the Virgin Islands to supply the United States with important insecticidal materials, which are now imported at high cost from foreign countries, will be investigated by W. W. Skinner, Assistant Chief of the Chemical and Technological Research Unit of the Bureau of Chemistry and Soils, United States Department of Agriculture. Doctor Skinner goes to the Virgin Islands at the request of the Department of the Interior, which recently was placed in charge of the islands and which is seeking to rehabilitate the agriculture by the introduction of new industries to take the place of the production of bay rum oil and sugar. These were formerly the leading native industries but have recently been suffering from the world depression and the overproduction of sugar. — (*Industrial and Engineering Chemistry*, Vol. IX, No. 5.)

SUGAR NOTES.

Compiled by the College Department of Sugar Technology.

1930-31 Sugar Beet Crop Returns in England and Wales.

According to the preliminary returns issued by the *Ministry of Agriculture and Fisheries* the area under sugar beet of 347,257 acres was the highest yet recorded in the history of the industry and showed an increase of 117,339 acres or 51 per cent. over the area of the previous year. The increase is partly attributed to the good results obtained in 1929 but also to the generally poor prices obtained for other farm crops. The weather was not, on the whole favourable to the crop. The sugar content was noticeably poor, the average for the season being 16.7 per cent. or one per cent. lower than in 1929. The yield of topped and washed beet per acre was high at 8.8 tons. The total beet harvested was about 3,042,000 tons and the commercial sugar produced 422,500 tons.

* * *

A Simple and Effective Method of detecting Inversion in and around the Factory Crushing Plant. *M. Bird.*

Paradoxical as it may seem, while the impurities of the cane congregate largely in the last mill juice, the glucose, which must be considered an impurity in the sense that it reduces the co-efficient of purity to the full extent of its presence, exists to a greater extent in the first juice expressed than in any subsequently crushed from the cane; and further the glucose content compared even with that of the sucrose is greater in the first juice expressed than in any other from the same cane.

The explanation is probably that the glucose, being stored more largely in the top, or soft part, of the cane, exudes most readily under the first pressure. The above statement presupposes, of course, that no inversion is allowed to take place in the juices before their analyses. The writer's experience is that, with mills kept sweet and clean, the glucose ratio is invariably higher in the crusher, or first mill juice, that in the mixed juice before liming, usually by a fraction of one per cent., and he has used this rule as a test for inversion in and around the milling plant.

It is evident that if there is any serious inversion in the mill, as is frequently complained of, the glucose ratio must rise in the mixed juice above that of the crushed or first mill. All that is necessary for the test is to take the glucose ratio of representative (preferably continuous) samples, over several hours, of the crusher or first mill, and of the mixed juices just before liming. Of course the samples must be preserved during collection, say, with one part of corrosive sublimate to 5,000 of each completed sample.

If the glucose ratio of the former juice is the higher, all is well, but if it is equal to, or lower than the latter juice, inversion, and consequently loss of sugar, is pretty sure to be taking place. If this is found to be the case, an effective remedy is to allow a small stream of milk-of-lime to flow into the last mill juice, if this is being returned, as it should be, to the first mill or into the maceration water if this is being applied behind the first mill. Formaldehyde has been used instead of lime, with apparently excellent effect.

Of course the samples should come in contact with the preservative immediately they are expressed, to prevent any after inversion, which, of course, would vitiate the results. As the writer does not know of this test for mill inversion having been used, except by himself, he thinks it well to offer it for publication in the belief that it will be useful to others. By glucose, of course, is meant the reducing sugars of the juices.—(*Int. Sugar Jr.*, Vol. XXXIII, No. 390.)

* * *

Labour Conditions in Hawaii.

The United States Bureau of Labour Statistics has issued a *Bulletin* (No. 534, March, 1931, pp. 29, price 45 cents) which is a survey of the general and social conditions in the Hawaiian Islands based on data collected during February-April, 1930. The inquiry was directed chiefly to labour conditions, in which the sugar and pineapple industries naturally figure largely. The labour costs of producing a ton of sugar on five sugar plantations are averaged as follows:

Clearing and ploughing	$ 1,102
Preparing and planting	866
Water supply	1,320
Cultivating	11,208
Fertilizing	397
Harvesting	6,772
Manufacturing raw sugar	2,547
General repairs and sundry expenses	4,177
Salaries	1,135
Grand Total	$28,389

In commenting on the matter of imported labour it is stated that excess of men over women and the continuing large importation of single men creates a social question which in the long run becomes a bigger problem that either the sugar or the pineapple industry, and that a labour policy more comprehensive than merely securing plenty of labour for these industries will sooner or later force itself upon Hawaii.

The point is raised also that it is neither socially, industrially, nor economically wise for Hawaii to import such a proportion of its total food supply as it does now. The tendency in one-crop or two-crop districts to ignore everything but the principal industry is not of course confined to Hawaii. Cuba, another sugar-cane country, imports from the United States fruits which grow wild in Cuba. The distance between Hawaii and the mainland of the United States, or any other country for that matter, is so great that importations of articles necessary for the needs of life and the ordinary comforts of living add so greatly to the cost of these things that eventually these costs will defeat the purpose of a cheap labour supply. (The *Bulletin* can be obtained on application to the Superintendent of Documents, Washington.)—(*Facts about Sugar* Vol. XXVI, No. 6.)

TREND OF THE MARKETS

[*The notes below are based principally upon running charts of the prices of the basic grades and upon general statistical information gleaned from contemporary publications and cablegrams and are intended to be a record of movements. An attempt is made, where possible, to indicate the market outlook at the time of going to press, but no responsibility for the accuracy and subsequent truth of such observations is assumed. Unless otherwise stated the prices quoted are spot, London.*]

SUGAR.—Prices on the Home Market have ranged as follows (c.i.f. per cwt.) :—

	Foreign.		*Preferential.*	
	s.	*d.*	*s.*	*d.*
28th May ..	6	0¾	9	10½
5th June ..	6	3	10	0
11th June ..	6	4½	10	1½
18th June ..	6	4½	10	1½
25th June ..	6	6¾	10	4½
2nd July ..	6	7½	10	4½
9th July ..	6	6	10	3

For the month of June price movements on balance, have been in favour of holders. Chief activity according to *Messrs. Czarnikow Ltd.*, has been centred in America where refiners, encouraged by a continued freer distribution of Refined, have shown willingness to make further additions to their stocks of Raws. The gradual improvement in the price level has, however, been subjected to considerable fluctuations due to the uncertainty as to how the current year's statistical position will finally work out. President Hoover's proposal for the postponement of all Government debt and reparation payment for one year has also helped towards a general upward movement of prices.

* * *

COCOA.—Recent announcement by Mr. Hoover has had a stimulating effect on the cocoa market and prices for all grades have shown appreciable advances. Stocks are not excessive and the statistical position remains strong.—(*By courtesy of the Cocoa Planters' Association of Trinidad.*)

* * *

TEA AND COFFEE.—The market for coffee has remained steady especially for Empire Brands, which include Jamaica, Kenya and Indian. The price of Costa Rica is somewhat unsettled and seems to tend downwards although it cannot be charted under 135*s.* per cwt. Bold size Jamaica has sold up to 223*s.* 6*d.* and Good ordinary at 48*s.* to 50*s.* per cwt.

Tea prices declined during the month of June and the averages are bad although they represent closing stages of a season. Packages of the new crop, however, have begun to arrive and the market is hopeful for July's new season's sales. Returns of tea consumption have shown a decidedly increased use of tea *per capita* in a number of countries. Latest averages include Ceylon, 11.57*d.* Indian 8.78*d.*; Java, 5.50*d.*

COPRA.—Copra shows a welcome recovery, West Indian f.m.s. being firm at £13.

* * *

BANANAS.—Jamaicas have continued in good demand the prices remaining unchanged from last Summary, *viz.*: £21 5*s.* per ton delivered London, and £21 delivered nearest railway station (wholesalers); retailers being charged from 10*d.* to 1*s.* per dozen. Brazilians remain in very good demand and prices are unchanged at £19 per ton delivered nearest railway station.—(*West India Committee Circular*, 25th June.)

* * *

RUBBER—Quotations for Plantation Sheet have ranged as follows :—

	d.
27th May	3 1/16
5th June	3⅛
10th June	3
17th June	3
24th June	3⅛
1st July	3¼
8th July	3 3/16

The market during the month of June was inactive and prices at the end of the month were inclined to be easier. According to *Messrs. Symington & Sinclair*, President Hoover's moratorium caused a good deal of "bear" covering and some buying on the long side, but the movement was mostly confined to market operators.

* * *

COTTON.—The following are the official Spot prices in pence per lb. of the Liverpool Cotton Association :—

	American Mid.	*Egyptian F. G. F. Sakel.*	*Sea Island.*		
			Good.	*Extra fine.*	*Prices paid this Week.*
29th May	4·80	7·80	17·00	33·00	—
5th June	4·78	7·65	17·00	33·00	—
12th June	4·75	7·55	17·00	33·00	—
19th June	4·75	7.45	16·00	32·00	14.00-18.50
26th June	5·43	8.20	16·00	32·00	14.00
3rd July	5·48	—	16·00	33·00	—
10th July (local)	5·05	—	16·00	33·00	—

Sea Island has continued quiet without quotable changes. The market for American re-opened with renewed selling at the beginning of June and remained active throughout the month.

* * *

LIME PRODUCTS.—*Lime Oil.*—Handpressed is very quiet, buyers showing little interest in available supplies. Quotations 40*s.* to 45*s.* per lb. nominal. Distilled has weakened, buyers holding off pending crop information. *Lime Juice.* Concentrated is neglected and quotations nominal. Small sales of Raw are reported at 2*s.* to 3*s.* per gallon. — (*West India Committee Circular*, 25th June.)